YEARBOOK

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OF

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EXPLORING AMERICAN ORCHARDS*

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AT THE MEETING of the Association of American Geographers in December, 1938, I presented a brief description of a method of detecting and analyzing regional trends on the basis of a single census or field survey without use of statistics of past years(1)†. The method involved the comparison of statistics of bearing and non-bearing trees, or of old and new houses. A large proportion of new units ordinarily indicates that expansion is in progress; paucity of new units ordinarily indicates shrinkage. My first theoretical statement used statistics already published, chiefly census material.

In the belief that the method would be valid and useful in field surveys, I undertook in the summer of 1939 a strictly morphologic field study of orchard trends in the United States and part of Canada from the Rocky Mountains to the Atlantic Ocean. The field method consisted in visiting all major and many minor fruit districts of the eastern and southern United States, and in each district driving by automobile through a representative cross section, tabulating to the nearest twentieth of a mile the linear extent of eash type of orchard and vineyard classified according to status of age and condition. During part of the trip I observed also the status of the accompanying houses. I soon found that the mere distinction between bearing and non-bearing trees, such as is reported in the United States Census publications for certain species, gave insufficient insight into existing trends; the following eight classes were therefore worked out in the field, and proved to meet the situation satisfactorily in all the districts visited:

Abandoned.

Remnant: A few scattered old trees, where once an orchard stood, still yielding a little fruit.

Decadent: Orchard in bad condition from neglect, though still producing some fruit.

Old bearing: Trees old, but still in close ranks and in commercial production. Often well cared for.

Poor bearing: Of normal bearing age, but neglected.

Bearing: The mature, productive part of most orchards.

Young bearing: Trees still small, and bearing light crops.

Non-bearing.

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*This paper is a summary submitted by Mr. Meigs in lieu of the presidential address he was scheduled to give at the 1940 meeting, which because of illness he was unable to attend. He summarizes here his field methods and illustrates, by citation of apple orchards he has observed, the kind of results he has obtained. His field work was made possible by a grant from the Social Science Research Council, New York, which partly defrayed his field expenses.

†Numbers in parenthesis refer to citations of literature at the ends of articles.

All these categories were of course not represented in every district. In tabulating in the field, I found it possible to cover the ground with the necessary speed and accuracy only with the aid of an assistant who recorded my dictation as I drove the car and observed. With a little practice it became possible to recognize quickly and accurately the class into which each passing orchard or plot should be placed.

The entire trip east of the Rockies covered 13,000 miles in 79 days. One thousand miles of actual orchards and vineyards were recorded, many of them in bits 0.1 and 0.05 mile long. The seven major fruit districts and more than thirty smaller but distinct orchard and vineyard districts of the East were visited. Though the districts are strikingly localized and disconnected, they can be grouped into five rather definite zones, as follows:

Citrus zone. Includes two major districts, Florida and the lower Rio Grande valley of Texas, and the small orange district of the Mississippi Delta Peninsula.

Transition zone. Southern Georgia, Alabama, Mississippi, and Louisiana, east-central Texas. Tung and pecan the chief orchards, with minor elements of Satsuma orange and Texas fig.

Peach zone. Georgia and the Carolinas west to central Arkansas and northeastern Texas.

Mixed deciduous zone. Northern Arkansas to southern Illinois on the west, to Virginia and the southern Hudson valley on the east. Northward extensions include the three major districts bordering the southern shores of Lakes Ontario and Erie and the eastern shore of Lake Michigan. Chiefly apples, peaches, and grapes, but also cherries and pears.

Apple zone. New England upland, Upper Canada, the Maritime Provinces, West Central Illinois.

In general, these zones extend northward in lowlands and southward in uplands.

For comparative localized study I have grouped the statistics recorded into 185 linear regional segments. The present brief report will draw upon this mass of statistical material for only one illustration of the method used. Data are summarized in Table I on apple orchards in nine orchard districts visited. For simplicity of presentation the eight classes of trees mentioned above have been consolidated into three broad groups: young, mature, and declining. The figures indicate the percentage of trees falling within each group.

TABLE 1. Classification of Apple Trees in Nine Orchard Districts

District	Percentage of Trees		
	Young	*Mature*	*Declining*
Northeast of Worcester, Massachusetts	25.2	70.4	4.5
Winchester, Va.	9.3	81.4	9.3
Southern Hudson Valley	15.1	72.3	12.6
Calhoun County, western central Illinois	14.1	75.7	10.2
East of Lake Michigan, southern section	12.2	77.8	10.0
South of Lake Ontario, New York	8.4	40.9	50.7
North of eastern end of Lake Ontario, Canada	8.5	53.4	38.0
Northwestern corner of Arkansas (3 counties)	4.5	51.1	44.3
East of Lake Michigan, northern section	3.8	23.1	73.1

The first of these districts, that near Worcester, Massachusetts, is apparently the healthiest, young trees totalling 25% and declining trees only 4.5%. The next four districts show a reasonably healthy condition, 72% to 82% of the trees being

in full production, and a fairly low percentage (9% to 13%) declining. Even in these districts, however, it is doubtful whether enough young trees are being planted to maintain the present acreage. The last four districts listed are definitely on the down grade, with large percentages of declining trees, very few young ones, and only 23% to 53% of the trees mature. The last district, in northern Michigan, provides the extreme example of dissolution, with 73% of its trees declining and less than 4% young.

While the main method of this study was morphologic, from time to time a number of formal and informal questionnaires were used in the field in order to gain a sampling of leading problems; and from these field interviews it has been possible in many cases to assign reasons for the trends observed. In the apple industry, for example, low prices are the main reason for regressive conditions. This factor, while nationwide, is particularly oppressive in less accessible districts, where returns to farmers are reduced by costs of transportation to market. The price factor is important in the Arkansas and Canadian districts. A heavy freeze in the winter of 1933-1934 caused death and injury to many orchards in apple districts about the Great Lakes and in New England that are not listed here.

In most orchard districts, low prices produce an effect upon the culture landscape comparable with that observed in the examples of apple districts mentioned above. A striking exception to the general rule was observed in the grapefruit districts of Florida and Texas, where there has been large overproduction in recent years and prices have been ruinously low. Yet the grapefruit groves, although in many cases loaded with rotting fruit, are usually maintained in first class condition, and planting of young trees continues. The reason for this is the social factor of tenure. Whereas the apple orchards are usually a source of all or part of the income upon which a resident farmer depends, a large percentage of the grapefruit orchards belongs to well-to-do absentee owners, who perhaps have their regular residences in New York or Chicago, where they make their living in business, and own a piece of land in Florida or Texas as a winter retreat, as a land investment, or as a source of hoped-for supplementary income. Even though they incur a loss in the grapefruit business, they can keep their investment or winter Paradise in good condition, for their regular businesses generally give them the means to indulge in their subtropical ventures. Thus the check on supply that would normally operate to reduce production at unprofitable prices is removed, and potential crops are kept so large that growers trying to make a living from their own groves often fail. Another factor that contributes toward maintaining the percentage of young plantings of citrus fruits is the activity of land companies that find a continuous market among Northerners for small planted citrus orchards, and who are therefore steadily planting their vacant holdings. In at least one case, too, I found a prosperous business man setting out fifteen acres of grapefruit on his estate in Florida so as to increase his expenses and thereby reduce his net income and income tax!

This summary has been able merely to suggest a few of the findings of last summer's survey. A fuller report must await more fortunate personal circumstances.

LITERATURE CITED

(1) An adaptation of the address before the Association of American Geographers, with illustrative statistical maps, is contained in my article, "A New Index for the Analysis of Regional Trends," *Scot. Geogr. Mag.*, 55: 161-170, 1939.

THE EDGE OF THE DESERT

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SOME GEOGRAPHERS and plant ecologists apply the term desert only to the most barren and extreme types of arid country. From the biological standpoint it seems desirable to adopt a broader conception of desert, as is done in the use of the word forest. The botanical earmarks of desert are the low stature and open spacing of the plants, and the presence of a few or many types of highly specialized plants. It is the many features of specialization in form, structure, physiological performance, and ecological behavior which identify the plants and animals of the desert in the broader sense of the word. The name "bush steppe" has been used for certain shrubby communities in the North American Desert, but is an unfortunate term which should be discarded. Such communities are in no sense steppe, and the presence of bushes as the matrix of the vegetation is characteristic of perhaps 90% of the North American Desert.

Both the physical and the biological features of the North American Desert suggest its subdivision into four areas: the Great Basin Desert, the Mojave Desert, the Sonoran Desert, and the Chihuahuan Desert. South of the last lies a region in which there are discontinuous areas of desert of a distinct type, for which the designation Hidalgan Desert is proposed. Parts of this area have been studied by Ochoterena(7), Bravo(2, 3), and Batalla and Cantu(1), but its exact limits have not yet been drawn.

The Great Basin, Mojave and Chihuahuan areas are entirely continental, while the Sonoran area is partly continental and partly coastal The periphery of the North American Desert, exclusive of the Hidalgan area, is approximately 9,500 miles. Of this distance about 7,700 miles are on land and constitute the boundary along which desert comes in contact with other types of vegetation. Certain parts of the edge of the desert are sharply drawn, especially where high mountains cause a marked change of environment within a short distance. Other parts of the edge are broad; and are occupied by transitional belts in which slope exposure, character of soil, and other local conditions may favor one or the other of the two adjacent vegetations.

If the edge of the desert is followed for a long distance it becomes obvious that the particular physical conditions which limit the desert in one place are different from those that limit it in another. The character of the vegetation bordering the desert changes radically and the species of plants involved in the transitions are not the same. Throughout the entire periphery of the North American Desert it is in contact with seven of the major types of vegetation of North America, as follows: chaparral, coniferous woodland, evergreen oak woodland, grassland, cactus savanna, semi-arid bushland, and thorn forest. The writer has published descriptions of the transition from desert to chaparral in Baja California(10), from desert to grassland in Chihuahua(9), and from desert to thorn forest in southern Sonora.(8)

The transition to chaparral is found in Baja California and southern California, as well as along the western base of the Sierra Madre Oriental in Nuevo Leon, as described by Muller.(6) The transition to coniferous woodland (juniper and pinyon) is found on all sides of the Great Basin and locally in Arizona. The meeting of desert and evergreen oak woodland occurs in southern Arizona, northern Sonora and Chihuahua, but is usually local, since these vegetations are commonly separated by grassland. The transition to grassland is found in Arizona, New Mexico,

Texas, and Chihuahua, and is commonly the most gradual of all of them. The transition from desert to cactus savanna may be seen in Durango and Zacatecas, where cactus savanna lies between desert and grassland. The transition to semi-arid bushland is found in Texas, Coahuila, and San Luis Potosi along most of the eastern edge of the desert. The transition to thorn forest is found only in southern Baja California and on the coastal plain of southern Sonora.

It is not possible here to go into the details of these transitions but merely to call attention to their importance in themselves and in the study of the desert. The types of climate which determine the surrounding vegetations are related to the climatic conditions of the adjacent sections of the desert. The physiognomy and structure of the desert communities have some relation to those of the adjacent vegetations, and the complexion of the desert flora is invariably strongly colored by the floras of nearby vegetations.

The nature and distributional area of a type of vegetation can not be based on the presence of a single plant species. They must be based on the entire plant population, on the kinds of life forms, on the structure of the plant communities, and on the species that are present. The plants of greatest importance in this connection are the ones that are very common and have large areas of distribution. The presence or absence of certain common species is one of the important data used in distinguishing vegetational areas, since it invariably affects all of the other criteria.

The plants which are abundant and widely distributed in the desert are either confined to it or range a relatively short distance beyond it into areas or habitats which offer conditions not radically unlike those of the desert. For example *Artemisia tridentata* (sage brush), one of the leading dominants of the Great Basin, ranges into the coniferous woodland and into open coniferous forest around the Great Basin. It is found well beyond the edge of the desert in the pine forests of southern California and northern Baja California. Similar extensions beyond the edge of the desert might be described for many other dominant species, but in every case the plant spreads in diminishing numbers or in special habitats.

The common plants of the vegetations surrounding the desert behave in the same manner that the desert plants do. They may not approach the edge of the desert or they may reach it in almost undiminished numbers and enter it for a short distance in favorable habitats. In many places in Nevada, Utah, and Arizona the juniper enters the desert for short distances and its presence tends to obscure the true position of the edge of the desert. The desert junipers are below the average stature, full of dead limbs, widely spaced, and associated with desert plants. In several localities in Arizona the range of the juniper overlaps the ranges of the desert dominants *Cercidium floridum* (palo verde), *Carnegiea gigantea* (giant cactus), and *Yucca brevifolia* (Joshua tree). In southern Sonora the dominant tree of the thorn forest, the espino (*Acacia cymbispina*), is found along drainageways 40 miles north of the edge of the desert. It becomes more abundant as the edge is approached, then occurs in scattered groves, and finally forms a continuous forest.

Present knowledge of the desert and its borders indicates that the uncommon species are less apt than the common ones to occur outside the ranges of their usual associates and beyond the limits of the desert. The same features of physiological constitution, structural fitness, and reproductive behavior that make a plant common where it finds optimum conditions also make it aggressive and successful in ranging beyond its usual associates.

The character of the conditions which determine the existence of large areas

of desert is well known. The precise conditions that are responsible for determining the boundaries on all sides of the desert are more complex and more poorly known. Livingston and Shreve(5) showed that the part of the North American Desert lying in the United States is limited by the isoclimatic line along which the ratio of rainfall to evaporation is 0.20. The data which enter into the determination of this ratio are of fundamental importance in connection with the water relations of plants. Biological phenomena, however, rarely admit of explanation on the basis of a single determining factor or of a single ratio or other composite expression of a small group of factors. The edge of the desert is the approximate line of demarcation between the distributional areas of two sets of plants with different life requirements. Not only do these requirements differ for the various plants in one section of the edge but they differ still more for the dominant plants in the several sections of the edge.

In order to determine more accurately the conditions which limit the distribution of the great communities of desert plants it is necessary to study the climate in detail and to know the ecological life histories of the plants involved. Each section of the edge of the desert then becomes a problem in itself. The limitation of each plant species requires independent investigation. The conditions which determine the location of the edge then become a composite expression of the ones found to be of greatest importance to the largest number of common plants.

The conditions which limit the distribution of desert plants are fairly well known for several species. The evidence is drawn from long familiarity with these plants in the field, observation of their habitat preferences and seasonal behavior throughout their geographical ranges, observation of their reaction to conditions of known intensity, and investigation of their physiological behavior. The interpretation of all the data bearing on any one of these species is broad enough to avoid the danger of mistaking mere concomitance for causality.

One of the best known desert plants is *Larrea divaricata* (creosote bush), the appearance and distribution of which are shown in figures 1 and 2. Without going into detailed evidence I wish to give a few conclusions about the limitation of the range of this wide-spread shrub as an example of the difference between the conditions which limit a desert plant on the various sides of its distributional area.

Larrea persists in extensive colonies in parts of Baja California in which there have been periods of four years without sufficient precipitation to wet the soil to a depth of one centimeter. It reaches its southern limit in North America on the plateau of Mexico in regions with a fairly dependable annual precipitation of 14 inches. Well established seedlings, free from competition, will grow in a soil of constantly high moisture content at a rate which is roughly 70 times the rate under adverse soil conditions. No part of North America is too dry for *Larrea*, and it extends a short distance beyond the edge of the desert in the direction of the most moist adjacent region on the plateau of Mexico. It does not, however, pass beyond the edge of the desert in Texas and does not reach it in southern Sonora. The behavior of artificially watered plants shows that high rainfall would not be directly prejudicial to well established plants. The rapid disappearance of *Larrea* at the northern and western edges of the arid bushland of Mexico indicates that it fails there to find suitable conditions for germination and establishment, and is unable to persist in competition with vigorous shrubs of greater stature. It has been seen at an elevation of 8,600 feet on the Picacho de las Bocas, in Zacatecas, where the rainfall is probably 20 inches, but occurs there only on thin stony soil where it is unshaded and without competition.

Larrea is absent from all but the southernmost edge of the Great Basin Desert. Its range in southern Nevada is approximately limited at the altitude of 4000 feet, with considerable variation due to slope exposure. In New Mexico the northernmost colonies are on south slopes near Socorro and the northernmost individuals about 30 miles southwest of Santa Fe at an elevation of 5,600 feet.

The northern edge of the range of *Larrea* is near the isoclimatic line for a maximum of six consecutive days of freezing temperature. There is, however, no experimental evidence to confirm the apparent importance of this datum in limiting the range of Larrea. Severe damage to the frontier plants after the exceptionally

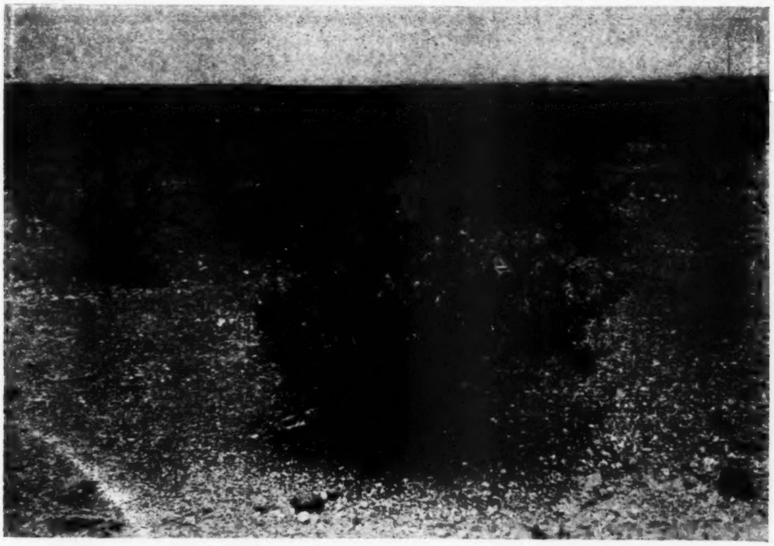

FIG. 1. Fruiting plant of Larrea divaricata near Tucson, Arizona.

cold weather of the spring of 1937 was described by Cottam.(4) Several botanists have noted the large number of dead plants found at all times along the northern edge of the range of *Larrea*, presumably indicating death from low temperatures.

Heavy snowfall is distinctly hostile to *Larrea.* The configuration of the plant and the inclination of the branches are such that the weight of the snow intercepted by the twigs and leaves flattens the entire plant. Recovery of the former position of the branches is never complete. The northernmost plants in New Mexico are habitually so depressed that they suggest creeping perennials.

The highest summer temperatures encountered by *Larrea* are in Death Valley and the Salton Sink. Since these are the warmest localities in North America it is obvious that high temperatures are nowhere concerned in limiting the range of the plant. The southernmost localities in Mexico are at elevations between 7000 and 8000 feet, where the summer maximum is from 20° to 30° F lower than in other parts of the range.

The only place in which the limit of *Larrea* is not understood is on the coast of Sonora. Between Hermosillo and Guaymas it is abundant near the coast but confined to isolated colonies in the interior. The southernmost known colony is near

the coast about 20 miles southeast of Guaymas. On similar terrain, and with a very similar climate, it extends 270 miles farther south than this in Baja California, where it is finally limited just north of Todos Santos by the prevailing granitic soils of the Cape Region. South of the Sonoran limit, and for 50 miles along the coast of Sinaloa the open arid scrub would seem to present favorable conditions for *Larrea.* The fact that such a wide-spread, vigorous and aggressive plant is absent there may yet be explained on the basis of present conditions.

The occurrence of *Larrea* from the bottom of Death Valley to the upper slopes of the mountains of Zacatecas gives it a vertical range of 9,000 feet. Such a range

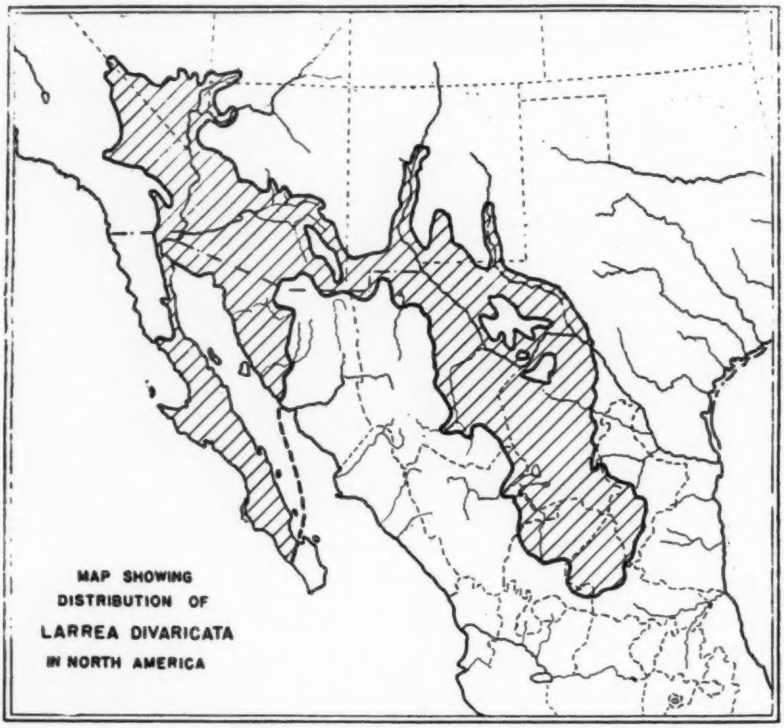

FIG. 2.

in altitude is exceeded by few flowering plants aside from certain arctic species which occur at sea level in the arctic and at high elevations on temperate and tropical mountains. *Larrea* also occurs in Chile and Argentina in a form which is now regarded as identical with the North American plant. The conditions under which it lives in South America have not been fully studied and described.

Several other desert plants that have been observed and studied in some detail are like *Larrea* in giving strong evidence that their distribution is limited by several sets of conditions in the various sections of their frontiers. Indeed, the same is unmistakably true of all plants which are sufficiently abundant and wide-spread

to justify the view that their ranges are controlled by the physical and biological conditions of the present.

For the majority of dominant plants in moist regions there is considerable evidence that they find their optimum conditions near the geometrical centers of their ranges. For desert plants this is frequently not the case. The centers of their areas are usually regions of great aridity, in which they are able to persist but do not reproduce as abundantly, occur in such heavy stands, or grow as rapidly as they do on approaching at least some section of their periphery. This is the case with *Acacia paucispina, Carnegiea gigantea, Franseria deltoidea, Fouquieria splendens*, and a number of other plants of the Sonoran Desert.

The plants growing in a vast area of virgin country may be looked upon in the same way that a plant physiologist views a series of cultures growing under predetermined experimental conditions. The ecologist measures the conditions instead of controlling them, and has the delicate task of interpreting the influence of a very large number of variables operating simultaneously. The physiologist and the ecologist are equally interested in two critical sets of conditions: those that represent the optimum for the plant and those that constitute the limiting margin of its existence. It is for these reasons that the ecologist is interested in both the center of his region and in the edge of his region.

LITERATURE CITED

(1) Maria Agustina Batalla and Debora R. Cantu, Contribución al Estudio Florístico del Valle de México, *An. Inst. Biol. Mex.*, 10: 227-267, 1939.
(2) Helia Bravo, Observaciones Florísticas y Geobotánicas en el Valle de Actopan, *Ibid.*, 7: 169-233, 1936.
(3) *Id.*, Observaciones Florísticas y Geobotánicas en el Valle de Mezquital, Hidalgo, *ibid.*, 8: 3-82, 1937.
(4) W. P. Cottam, Has Utah Lost Claim to the Lower Sonoran Zone?, *Science*, 85: 563-564, 1937.
(5) B. E. Livingston and Forrest Shreve, The Distribution of Vegetation in the United States as Related to Climatic Conditions, *Carnegie Inst. Wash. Publ.* no. 284, 1921.
(6) C. H. Muller, Relations of the Vegetation and Climatic Types in Nuevo Leon, Mexico, *Amer. Midl. Nat.*, 21: 687-729. 1939.
(7) Isaac Ochoterena, Esquemas Biotípicos y Sinecias Características de las Regiones Geográfico-botánicas de México, *An. Inst. Biol. Mex.*, 8: 463-597, 1937.
(8) Forrest Shreve, Lowland Vegetation of Sinaloa, *Bull. Torr. Bot. Club*, 64: 605-613, 1934.
(9) *Id.*, Observations on the Vegetation of Chihuahua, *Madroño*, 5: 1-13, 1939.
(10) *Id.*, The Transition from Desert to Chaparral in Baja California, *ibid.*, 3: 257-264, 1936.

PHYSIOGRAPHIC DIVISIONS OF THE COLUMBIA PLATEAU

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IN THE Pacific Northwest is located one of the largest areas of volcanic rock on the earth's surface, covering more than 200,000 square miles. Much of this area is drained by the Columbia River and its tributaries, and hence has been generally spoken of as the Columbia Plateau, although it is really not a plateau at all, but rather an intermontane lava-covered region between the Cascades and

FIG. 1. The selection of a name for the sloping section between the Blue-Wallowa Mountains and the Palouse Hills proved difficult. After calling the section tentatively Blue Mountain Slopes, Piedmont Slopes and Marginal Slopes the author has decided on naming the section Tri-State Slopes. This decision was made in time to change wording in the text but not on the map on which Marginal Slopes should read Tri-State Slopes.

northern Rocky Mountains. Most of the so-called Columbia Plateau is upland with elevations of from 1,000 to 5,000 or more feet above sea level, but some of the surface consists of basins of only a few hundred feet elevation. The same types of lava flow as are observed in the lower country have been uplifted in the Wallowas, Seven Devils and Blue Mountains to elevations of nearly 10,000 feet. The Columbia Plateau is far from having the uniform surface generally thought of as

characteristic of plateaus; but instead it possesses a highly varied surface of small plateaus, both level and tilted, of hills, eroded slopes, high rugged mountains, broad valleys and basins, anticlinal ridges and flat plains. Moreover, instead of rising abruptly on at least one side as plateaus are said to do, the area is enclosed by mountains on the west, north, and east, and grades almost imperceptibly into the Great Basin to the south.

Fenneman(1) divided the Columbia Plateau into five sections. Most of that in Washington and in central Oregon was included in what he called the Walla Walla Plateau, said to have a rolling surface with young incised valleys. However,

FIG. 2. Scabland tract near Cheney, showing isolated hill of Palouse soil and topography surrounded by "Scabrock" from which the soil was removed by floods of glacial melt water.

the term Walla Walla Plateau is never used by the local residents, and this region varies so greatly in its relief features that the term is inept and inapplicable and separation into several regions was found desirable. The Blue Mountain section, according to Fenneman, consists of complex and dissected volcanic plateaus and forms a definite, easily identified region that is acceptable save that the Seven Devils and Wallowa Mountains are described separately in this paper. The southern part of the Columbia Plateau was divided by Fenneman from west to east into a Harney section, a Payette section, and the Snake River Plain. These sections are retained, although some changes are made in Fenneman's boundaries and a new section, the Owyhee, is added. The Harney section is mostly retained, but is considered transitional to the Basin and Range Province.

On the basis of differences in physiographic relief it has been found desirable to divide the Columbia "Plateau" into twelve main divisions: 1, Waterville Plateau; 2, Palouse Hills; 3, Channeled Scablands; 4, Central Plains; 5, Yakima Marginal

Folds; 6, Blue-Wallowa-Seven Devils Mountains and connecting Snake River High Plateau; 7, Tri-State Slopes; 8, Deschutes-Columbia Plateau; 9, Payette Section; 10, Snake River Plain; 11, Owyhee Section; and 12, Harney Basin. (Figure 1.)

The Basin and Range Province, like the Columbia Plateau to the north, contains much recent lava, but the fault block mountains and detritus-filled valleys and playa lakes between the uplifts are recognized structures characteristic of the "Great Basin" and hence the country of southern Oregon that has such relief is not included here in the Columbia Plateau.

Waterville Plateau. The lava flows of the northwestern corner of the Columbia

FIG. 3. Palouse Hills, between Medical Lake and Reardan photographed from the Northwest. Remnants of snow banks are on steep northeast slopes while the gentle slopes are to the southwest.

Plateau overlap the mountain slopes of older rock to the north and west and extend up the Okanogan Valley to Omak. The southern and southeastern sides of the plateau are determined by monoclinal folds where the relief descends a thousand feet from the plateau to the Quincy and Hartline Basins. Across the moderately rolling surface of the Waterville Plateau extend deep canyons of the Grand Coulee and Columbia River, the latter also forming part of the western border of the plateau. Moses Coulee does not completely cross the plateau. South of Waterville an upfold, the Badger Mountains, rising above the otherwise gently rolling surface of the region, is included in the folded marginal section to the southwest. The northern part of the Waterville Plateau was covered by ice of the Okanogan Lobe of the Cordilleran Ice Sheet, which deposited a prominent moraine extending in a horseshoe shape for thirty miles south of the Columbia River across the surface of the plateau from its western margin to the Grand Coulee. Huge erratic boulders, mostly of basalt, called locally "haystack" rocks, are a feature of the glacial

deposits. Grand Coulee and Moses Coulee were chiefly formed from erosion by melt water from the Ice Sheet.

Palouse Hills. The Palouse Hills occupy the eastern edge of the plateau between the Spokane and Snake Rivers west to the unique, curious scabland tracts that extend from Spokane southwesterly to the confluence of the Palouse and Snake Rivers. Palouse Hills are underlain by basalt flows. They are not, however, composed of residual material from these rocks, but instead are built of loess blown from the dry basins to the southwest mixed with volcanic ash, and heaped into hills, elongated from the southwest to northeast and steepest in the latter direc-

FIG. 4. Beginning of the Tri-State Slopes north from the Blue Mountains in southeastern Washington. Note the contour cultivation of the field and greater erosion on slopes not farmed on the contour.

tion. (Figure 2.) Wind, nivation and reshaping by running water have united to form the hilly, mature topography of the Palouse. Four tongues of the Palouse region extend across the Washington border into Idaho between Coeur d'Alene and Lewiston. Hills of old crystalline rock, like Steptoe Butte, that were the highest projections of the old surface and which were surrounded by lava but not covered by the basaltic flows, project above the general level of the country and increase in numbers towards the mountains of Idaho.

Channeled Scablands. Between the Palouse Hills and the Waterville Plateau is an area that in preglacial times was completely covered with soil and that had then a relief resembling the Palouse; but from which during the Glacial Period about half of its former covering of soil was removed by floods of glacial melt water, which left the higher loess-covered areas as "islands" between areas of bare lava rock called "scabrock" by the early pioneers. The areas of scabrock follow definite channels that intertwine together in a bewildering way down the slope of the plateau toward the Snake River and Columbia Basin from the Spokane and

Columbia River divide, located near the north edge of the lava plateau. (Figure 3.) The term Channeled Scablands was applied to this area by Bretz(2); it represents a region of very youthful relief with rock walled lakes, swamps, buttes, rock mesas, and other erosion forms incised into the mature topography of the Palouse. The Scablands are a peculiar type of relief and appear to be the only example of the sort in this country.

Central Plains. This section includes what is often called the Columbia Basin of Washington and has a desert or semi-desert climate. It is surrounded by higher land and has a relief consisting of gentle slopes and flat, detritus covered plains.

FIG. 5. Snake River Plain in south central Idaho near Mountain Home taken from the south. The cultivated land is irrigated on both sides of the Snake River for several miles. Rough young lava flows begin about ten miles beyond the river to the north, and beyond the lava flows rise the Rocky Mountains.

The Saddle Mountains and Frenchman Hills extend from west of the Columbia River well into the "Big Bend" region of that stream, almost cutting the Columbia Basin into two parts, the Quincy Basin lying north of the ridges, and the Pasco Basin to the south. Lake beds and fluvial deposits of gravel, sand and silt cover much of the surface of the Columbia Plains. The south border is the Horse Heaven Hills and on the west are other hills of the Yakima Folds. Northwest is the Waterville Plateau, and northeast and east the plains change to slopes that grade into the Channeled Scablands and Palouse Hills. The section extends between the Horse Heaven Hills and Blue Mountains into northern Oregon to include the so-called Umatilla Basin, a detritus covered plain.

Yakima Marginal Folds. The term Yakima Marginal Folds is applied to a series of upfolded hills and ridges alternating with synclinal valleys that extends eastward from the southern half of the Cascade Mountains in Washington, between the Columbia River on the south and the Wenatchee Valley on the north.

The Horse Heaven is the longest of the uplifts and lies in the extreme south of Washington. The Horse Heaven extends east beyond the Columbia River which cuts across near the end of the fold in the Wallula Gateway, a mighty watergap nearly 2000 feet deep. Along most of their length, both the north and south slopes of the Horse Heaven are steep fault scarps. The fertile, irrigated Yakima Valley begins at Benton City and extends upstream, northward beyond the city of Yakima. The Yakima Valley is nearly severed into an upper and lower valley by a ridge that is crossed by the Yakima River at Union Gap, south of Yakima city. Several associated tributary valleys extend east and west on both sides of the main valley. Beginning a few miles north of Yakima the Yakima River has cut a series of stupendous entrenched meanders through several upfolds of basaltic lava. North of these ridges is the Kittitas Valley which is bounded on the east by the Saddle Mountains and on the north by the old rocks of the Wenatchee range. The uplifted lava flows of the eastern part of the Wenatchee Range as far west as Table Mountain are included with the Yakima Folds, together with the lower end of the Wenatchee Valley and the Badger Mountains of Douglas County. The section projects into the Columbia Basin east beyond the river in two folds, the Saddle Mountains and the Frenchman Hills. The ridges of the Yakima Folds trend in a generally easterly direction from the Cascade Mountains. The western boundary is obscure, since both lava flows and erosion slopes may extend from high in the Cascades well out into the eastern sloping plateau-like summits of the marginal folds. The section in the southwest is assumed to extend to the canyon of the White Salmon River. In general, the western border is determined by the fact that the Cascades show a greater degree of erosion, with sharper incisions into bedrock, and have a greater declivity of slopes than the Yakima Folds, but in many places the drawing of an exact line is difficult. The valleys between the ridges contain lake beds and fluvial deposits which have been reworked by the Yakima River and other streams to form benches or river terraces that are characteristic and widely distributed. A small folded area extends across the Columbia River into Oregon near Hood River.

Central Mountains. In central and northeastern Oregon and extending into Idaho and a short distance into Washington are the Blue Moutains, Wallowa Mountains, Snake River High Plateau and Seven Devils Mountains, the last wholly in Idaho. Essentially these uplifts form one mountainous section or subprovince.

Blue Mountains. The intermountain lava covered Columbia Plateau is nearly divided into northern and southern parts by a series of elevated lava plateaus and faulted or folded mountains, that stretch southwestward from the Rocky Mountains of central Idaho to within forty miles of the Cascades near Prineville, Oregon. The general term of Blue Mountains is applied to these uplifted and dissected plateaus and ranges that extend for 200 miles from southeastern Washington first southward and then westward to central Oregon. Intermontane basins and broad valleys are characteristic of the Blue Mountains, both within and along the margins of the uplifted blocks. On the east the Grande Ronde Valley and the Baker Valley separate the Blue Mountains from the Wallowa Mountains in northeastern Oregon. Essentially the Blue Mountains are horsts whose fault scarps are steepest on the south and east. The northern part of the Blue Mountains consists mainly of warped and sometimes tilted plateaus, all highly dissected. The southern flanks of the mountains are more rugged and affected by stronger folding and faulting than the northern portion. Elkhorn Ridge, west of Baker, and the Strawberry and Aldrich Ranges further west, are examples. The western extension of the Blue

Mountains, ending near Prineville, is called the Ochoco Mountains. In places lava has been uplifted in the Blue Mountains to elevations of more than 9000 feet. In general the higher peaks are composed of ancient crystalline rocks; they may represent hills that were surrounded by lava flows but never covered by them. In other cases erosion has completely removed the lava, and exposed the underlying granodiorite and other crystalline rocks in the heart of the mountains. Considerable mining, mainly for gold, has been done in these areas of old granodiorite and the associated placers deposited downstream. Marine sediments, lake beds, and other terrestrial deposits, mixed in part with volcanic ash and lava flows, outcrop in the region drained by the John Day River and its forks on the northwest slopes of the Blue Mountains and are also well developed in the Ochoco Mountain uplift. The sediments are attacked more effectively by erosion than the lava, and the resulting relief features are characteristically affected.

Wallowa-Seven Devils Mountains and Connecting Snake River Plateau. The Wallowa Mountains contain the highest peaks in northeastern Oregon. They consist of a mountain mass about 30 miles across with a center of old crystalline rock away from which dip the lava flows that originally were deposited approximately horizontally around the range. In the Glacial Period the Wallowas were strongly eroded by ice; small remnant glaciers still exist, and the mountains contain the most alpine scenery of northeastern Oregon.

Across the Snake River in Idaho, west of the Salmon and White Salmon Rivers, are mountains of a character similar to that of the Wallowas. While it is not certain, it seems probable that this rugged region, called the Seven Devils Mountains, had peaks that always have projected above the surface of the surrounding lava. Between the Seven Devils and the Wallowas the entire region was once buried by thousands of feet of lava. Then both the basalt and the two mountain areas were uplifted, the movement being accompanied by some faulting which helped to affect the relief and drainage. This high upwarped plateau attained elevations of 8000 feet or more, and has been severed by the great Snake River Canyon which for one stretch of nearly 40 miles averages nearly 6000 feet in depth. The author suggests that the connecting plateau between the Wallowas and Seven Devils Mountains be called the Snake River High Plateau. South from the Seven Devils Mountains stretches a disturbed, sloping, lava-covered plateau whose surface dips beneath that of the Snake River Plains north of Weiser. The northern border of the Wallowa uplift is the Wallowa Valley on its north side, and that of the Seven Devils is assumed to be the canyon of the Salmon River.

Tri-State Slopes. This term is applied to the sloping surface of the Columbia Plateau that descends from the Blue-Wallowa-Seven Devils Mountains to the Snake River on the north and northeast. Included also is the Craig Mountain area in Idaho that extends east to the Rocky Mountains from the Snake between the Clearwater and Salmon Rivers. The section is assumed to end on the uplands east of Walla Walla. Somewhat similar sloping surfaces in north central Oregon are included with the Deschutes-Columbia Plateau section. The section is marginal to the mountains and could almost be described as a sloping piedmont district. The Tri-State Slopes are trenched by canyons that cross from the Blue Mountains to join the Columbia or Snake rivers; the surface has in some places been eroded into hills that somewhat resemble those of the Palouse. (Figure 4.) In general, however, the soil is mainly of volcanic ash and thinner than in the Palouse and the hills are much longer and lack the prominent steep-sided amphitheaters on the northeast side of the hills that are characteristic of the Palouse Hills.

The surfaces of the high slopes north of the Wallowa Mountains have been deeply trenched by the Grande Ronde, Imnaha, and Snake rivers, so that the relief is one of alternately rather level or sloping plateau surfaces and appalling canyons thousands of feet deep that are very difficult to cross. This northeastern part, beginning with the divide north and northwest of Asotin Creek, might be called the Grand Ronde Slopes after the most prominent stream that cuts across its surface. Craig Mountain in Idaho lies between the Seven Devils and Rocky Mountains, and the Clearwater and Snake rivers. Essentially it consists of a somewhat dissected tilted plateau.

Deschutes-Columbia Plateau. This section consists of that part of the Columbia Plateau from the Cascade Mountains to near Pendleton at the foot of the Blue Mountains. The western part is drained by the Deschutes River, and along this stream the surface rises regularly from the Columbia River to beyond Bend in central Oregon. The eastern part begins at the high bluffs facing the Columbia, and slopes gradually upwards to meet the Blue Mountains. South of Bend is found a region of very recent volcanic activity, with rough black lava flows, scores of cinder cones, lava tubes, etc. To the east this area grades into the desert basins of central Oregon. Much of the surface between the canyon of the Deschutes River and the Cascade Mountains is covered with stones and gravel washed down from that range, especially during the Glacial Period. The canyons of the Deschutes and its main tributary from the east, the Crooked River, are deep and narrow throughout much of their length. Good soil covers the surface of the plateau on the north, from Hood River and The Dalles eastward. Here the rainfall is adequate and a good farming country has developed which produces large amounts of wheat, but toward the south around Bend, Redmond, and Prineville, the rainfall drops off and irrigation becomes necessary. Here the irrigated land consists mainly of the river flood plains and pockets of fertile soil that have developed between the lava flows.

Payette Section. This name was applied by Fenneman (3) to the western part of the Snake River downwarp which contained considerable recent sediments and is more dissected than the Snake River Plain to the east. However, the Owyhee uplands to the south are separated, in this paper, from the Payette Section to which they were attached by Fenneman. The Idaho portion of the Payette Section was the site of extensive interior lakes between periods of volcanism, and as the lake beds are easier to erode than the lava, the country is more dissected than the eastern part of the Snake River Plains. King Hill is about the dividing point between the Payette and the Snake River Plain. The Payette extends westward into Oregon to include a dissected lava-covered region drained by the Malheur and lower Owyhee rivers. From a human standpoint the Payette Section has a deeper soil, lower elevation and longer growing season than the Snake River Plain to the east, so that a larger variety of crops can be raised there than in the middle and upper Snake River Valley.

Snake River Plain. This name is applied to the crescent-shaped lava-covered country drained by the Snake River from Yellowstone Park southwest to the vicinity of King Hill in southern Idaho. The Snake River Plain drops from an elevation of about 5000 feet on the east to about 2000 feet on the west in the Payette Section. This drop of 3000 feet in about 400 miles, or eight feet to the mile, has resulted in the development of the great canyon of the Snake River and of several waterfalls of which Shoshone Falls, 200 feet, and Twin Falls, 120 feet, are the highest. The eastern half of the Snake River Plain is underlain by younger lava

than the western portion. In fact, in the Craters of the Moon country, some of the most recent volcanic activity in the United States has occurred. The Snake River Plain slopes toward the south as well as toward the west, and the river is asymmetric with the depression, flowing along the course of an arc across the plains toward the south side of the low land. (Figure 5.) Having a desert climate, the inhabitants require irrigation for successful agriculture and the strip of country ten or twelve miles wide on either side of the river is devoted to farming and is popularly called the Snake River Valley.

Owyhee Plateaus. In southeastern Oregon and southwestern Idaho a series of high warped plateaus is drained by the Owyhee River; they are included together here to form a section called the Owyhee. The suggestion for doing this was made by Alfred L. Anderson, Cornell University (unpublished manuscript). The part of the Owyhee uplift lying in Idaho is highest and is called the Owyhee Mountains. Here erosion has exposed ancient, mineral-bearing crystalline rock which is surrounded by high cuestas of uneroded lava. Acid lavas predominate in the eastern part of the Owyhee Section, but they have been mainly covered by basalt in the western portion. The Owyhee and its tributaries cut deep canyons in their course across the high desert uplifts of the Owyhee plateaus, which extend a short distance south of the 42nd parallel into Nevada.

Transition to the Great Basin. South of the Blue Mountains, between the Deschutes Plateau and the Owyhee uplift, is a desert basin section that contains lava, volcanic ash, lake beds and detrital deposits. The eastern part has been called the Harney Basin for many years, and the name could be applied to the entire area. The western half is locally called the Great Sandy Desert or High Plains. This is largely covered with fine volcanic debris, and presents a uniform flat and desolate appearance without stream valleys or elevations. The Harney Basin drains toward Harney and Malheur Lake, the latter a playa that varies greatly in area, depending upon the rainfall and run-off. In the Harney Basin, surrounding the central shallow lakes and playas, are alluvial plains and a small volcanic area of cinder cones and lava beds; further out are marginal plains somewhat dissected by erosion. The Harney Basin and Great Sandy Desert have interior drainage. A number of minor fault scarps break the surface, representing a sort of transition from the true basalt-covered Columbia "Plateau" to the Great Basin, or better the Basin and Range Province, to the south.

LITERATURE CITED

(1) Nevin M. Fenneman, Physiography of Western United States (New York, 1931): 226-273.

(2) J. Harlan Bretz, Channeled Scablands of Eastern Washington, *Geogr. Rev.*, 18: 146-477, 1928.

(3) *Op. cit.*, 244.

TYPE CURVES AND DURATION OF SNOW COVER IN WASHINGTON

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IN THE past few years there has been an increasing demand for more detailed studies of various characteristics of snow cover in areas where the snow lies on the ground for some time during the winter. In this country studies of certain features of snow, particularly depth on ground and duration, are being pursued by R. G. Stone for New England and New York(1) and by Eric Miller for Wisconsin(2). A preliminary report on the snow cover of Washington was presented before the International Commission of Ice and Snow of the International Union of Geodesy and Geophysics at its Seventh Assembly, Washington, D. C., 1939. The present report on types of seasonal curves of snow depth and duration of snow cover is also preliminary.

Data. The report is based on the records of snowfall kept at first order and cooperative stations of the United States Weather Bureau. Nearly 100 stations have been used, a majority of which have had unbroken records during the 20-year period 1918-19 to 1937-38. Less than 10 stations had records shorter than 10 years. No adjustment of short records has been made as yet. Though the snowfall records include amount of fall each day, depth on the ground on the 15th and last day of each month, water content (melted), and total snowfall during the season, only depth on ground on the 15th and last day of each month are used here. The duration of the snow cover was computed from the curves of depth on the ground on the 15th and last day of each month.

Snow on Ground during Winter Season. The situation of the state of Washington and its complex relief result in almost innumerable combinations of temperature and precipitation. The controls that have the greatest effect on the distribution of snow, its depth on the ground, and its duration are latitude, position to leeward of a relatively warm ocean, occasional westward spread of continental air, and relief.

Briefly, the depth on ground and the duration of snow cover are largely dependent on altitude. In the higher mountains above 6,000 feet the snow season begins about the middle of October. By the first of November there is a continous blanket of snow above 3,000 feet on the western side of the Cascades, though there is none at that altitude in the Blue Mountains or in the Okanogan Highlands. By the middle of November, snow covers the surface down to about 1,500 feet on the western side of the Cascades and a thin cover extends down to 2,000 feet on their eastern side.

In early December the snow cover is continuous above 1,000 feet on the eastern side of the Cascades. During the first two weeks of December all of the Puget Sound area becomes covered, and all the "Inland Empire" is also under snow. Only the immediate coast along the Pacific is free of snow. By December 15 the area covered is as great as in January, and above 3,000 feet the average depth is in excess of 30 inches.

By the first of the year the Puget Sound Lowland has no snow below about 1,000 feet. The "Inland Empire" generally has experienced a little increase in depth, but about the confluence of the Columbia and Snake Rivers, the lowest altitude in eastern Washington, the depth has decreased to about one inch. The depth on the ground above 1,500 feet, both east and west of the mountains, has

increased materially. By January 15 the pattern has again changed; all the Puget Sound Lowland, except along the immediate shore and the San Juan Islands, now has a snow cover, although it averages less than one inch in depth. On the last of January the pattern is the same as on the 15th except that the snow is deeper over the whole state. More than half the stations report their deepest cover at this date. These stations are below 1000 feet elevation on the western side, and between 2,000 and 2,500 feet on the eastern side, of the Cascades. The rate of increase of depth of snow in the mountains reaches its maximum value during this month.

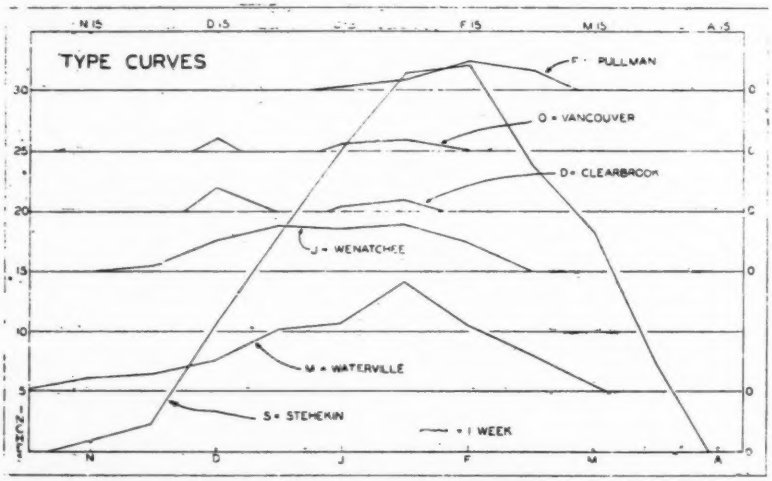

FIG. 1. When the curves drawn for individual stations are sorted according to form, they fall into one or two of the six types plotted. Interval between horizontal lines, 5 inches depth. Scale at left refers to the curve of type "S"; the horizontal lines represent zero depth for several curves, as is indicated at right.

By the middle of February there has been some diminution of the area covered both east and west of the mountains. Stations west of the Cascades at altitudes between 1,000 and 2,000 feet have their greatest depth at this date, but on the eastern side the stations that have their maximum depths for the season at this time lie between 2,500 and 4,000 feet. At higher altitudes the snow continues to become deeper. By the end of the month all the Puget Sound Lowland is free of snow except near the Columbia River Gap.

By the middle of March the snow is gone from the "Inland Empire" and only the mountains above 1,000 feet on the western side of the Cascades and above 2,500 feet on the eastern side have snow. Melting is rapid during this month; at the end of March there is little snow left in the Okanogan Highlands and the Blue Mountains, but above 3,500 feet on the western side of the Cascades the snow attains its maximum depth. Paradise Inn then has 184 inches, Mount Baker 175, and Snoqualmie Pass 92 inches.

In the middle of April only a small patch of snow is left on the Blue Mountains. This is gone by the end of the month. The Cascades and Olympics still have much snow, but it is rapidly melting at all altitudes.

Type Curves. Though each station has its own particular seasonal curve of depth of snow on the ground, many curves resemble one another. All the curves have been classified into groups having certain common characteristics. The classification gives the following six types:

F. Greatest average depth on ground February 15; depth at that date less than 10 inches.

O. Snow cover not continuous during the winter; maximum depth January 31; depth on December 15 greater than on December 31.

D. Maximum depth during season on December 15: cover not continuous

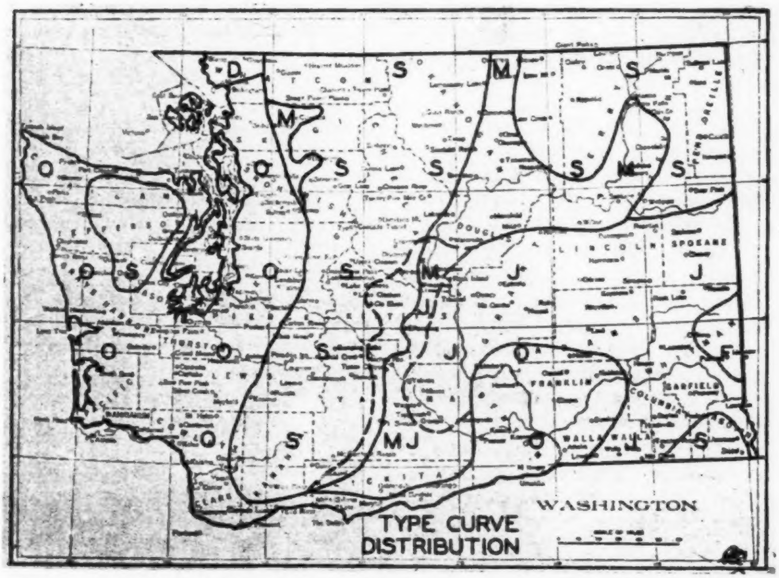

FIG. 2. Areal distribution of the six types of snow curves. The "M" type is probably present along the entire western slope of the Cascades, but within too narrow a strip to be shown cartographically.

through winter.

J. Greatest average depth on ground January 31; depth at that date less than 10 inches.

M. Greatest average depth on ground between 5 and 10 inches; depth on December 31 either greater than that on January 15 or nearly equal to it.

S. High altitude curves. Dates of average maximum depth vary, but maximum depth is greater than 10 inches.

An example of each of these types of curve is reproduced in figure 1. Some curves were found that fit easily into either of two classes. That fact does not detract from the value of the classification, though the definitions used are chosen arbitrarily: the curves that exhibit characteristics of two of the types defined pertain to stations along the boundaries between areas in which the pure types dominate. They mark the width of the transition zones between the areas where the pure types occur.

Areal Distribution of Types of Seasonal Curve. Figure 2 shows the areal distribution of the types of seasonal curve defined above. If the Olympic Mountains are omitted for lack of data (at high altitudes this area undoubtedly has the *S* type of curve), the entire western part of the state up to an altitude of about 1,000 feet has the *O* type. The shape of the discontinuous curve and the small amount of snow on the ground are the result of low altitude, rainy air from off the Pacific, and the mountain barrier that effectively prevents all but a few flows of cold continental air from reaching the area. Within the past 20 years, however, and especially in 1922 and 1927, snow has been on the ground on December 15 no less than five times. None has ever been observed on the ground at the end of December, the rainiest month. At the northernmost extreme, Blaine and Clearbrook fall in the *D* type because the amount of snow on the ground during the season has its maximum in the middle of December. This fact is to be ascribed to the lifting of the southwest wind by cold air draining down the valley of the Fraser River.

The *S* type, found only in the mountains, can be accounted for by high altitude regardless of situation. It is to be expected that where a moist wind is first lifted most of its moisture is dropped. To the lee of the crests of the mountains, much of the snow cover is the result of carry-over. The amount, therefore, decreases rapidly to the east of the position of highest ascent of the air from which the snow is precipitated. Little snow falls from an east wind, because the air from that sector is too dry.

Along the flanks of the Cascades, particularly on their eastern slope, the *M* type occurs. South of Waterville, the *M* type is merely transitional between the *S* and *J* types, and the area in which it occurs is narrow except over the Horse Heaven Hills. To the north, the Waterville Plateau, and the area adjacent to the Columbia, the Okanogan, and probably the Clark Fork and Sempoil Rivers, are high enough to produce the *M* type of curve.

Between altitudes of about 1,000 and 2,500 feet in the "Inland Empire" the *J* type is found. The snow cover, though relatively thin, is continuous through the winter. Toward the east, about Colfax and Pullman, the depth on the ground increases somewhat, and the maximum depth occurs in the middle of February. This area, assigned to type *F*, has an altitude of about 2,500 feet, and receives more snow than areas farther west as a result of being within the range of influence of ascent of air over the nearby mountains of Idaho.

The area below 1,500 feet about the confluence of the Snake and Columbia Rivers has the *O* type of western Washington. This type may be attributed to the low altitude and the free passage, without ascent, of air from the Pacific through the Columbia Gap. Though the average curve of depth on ground is not discontinuous, nevertheless the depth on the ground at the end of December is negligible.

Duration of Snow on the Ground. Maps of average depth and of average duration of snow cover (not reproduced here) show a close relation to altitude. But in some places, especially in long, low, narrow, and protected valleys, the snow lingers longer than would be expected.

Most of Puget Sound Lowland has a total average duration of snow cover less than five weeks, the sum of the values for December and January. Between Everett and Bellingham, the low Skagit Flat, which is exposed to the longest fetch of wind on the Strait of Juan de Fuca and is outside the trajectory of the cold air that flows down the Fraser River Valley, the snow lasts but three weeks, the period being again separated into two parts. This same duration is found in the "open rain gate" between the hills of Pacific County and the Olympic Moun-

tains. Along the immediate shore of the Pacific Ocean the duration shrinks to one week or less. Here the temperature of the surface water of the Pacific keeps the land too warm to permit the small amount of snow that falls to remain.

Along the Columbia River upstream from Kelso, the duration of snow cover increases to about ten weeks and then remains constant up to the limit of the *O* type of the "Inland Empire," near Wahluke. From Wahluke the season of snow cover increases in length in all directions, except toward the south, in proportion to increases in altitude. The *J* type has a duration of 10 to 20 weeks, the greatest depths occurring during the month of lowest temperature. To the east, the *J* type passes directly into the *F* type, in which the season of continuous snow cover is more than 15 weeks long. Westward the season increases slightly in length, to 18 weeks at Okanogan and 19 weeks at Waterville in the *M* type. The minimum duration of the snow cover in the *S* type is approximately 20 weeks; in the Okanogan Highlands, Republic has snow during 21 weeks and Colville no less than 26 weeks. In the Blue Mountains, Anatone, at 3,800 feet, has a snow cover during 25 weeks. Along the foothills on the western side of the Cascades, the duration of snow increases very rapidly with increasing altitude. At Snoqualmie Falls (430 feet) the snow remains on the ground fully 9 weeks, while at Snoqualmie Pass (3,017 feet), only 30 miles distant, the snow lasts 30 weeks. Between these two altitudes, Silverton has a duration of 28 weeks, and Guler (1960 feet) of 26 weeks. The longest seasons are naturally recorded at the highest and snowiest stations, Mount Baker (4,400 feet) and Mount Rainier (5,550 feet). At the latter station, the long record available shows an average duration of fully 40 weeks.

In Table 1 the several types of curve are brought together, and for each type the maximum and minimum duration of cover are given, together with their ranges in altitude and the parts of the state in which they occur.

TABLE 1

TYPE	DURATION (weeks) *Minimum*	*Maximum*	RANGE OF ALTITUDE (feet)	LOCATION
D	—	5	0 to 500	North of Bellingham
O	1	5	0 to 1500	West of Cascades
O	5	10	500 to 1000	East of Cascades
J	10	20	1000 to 2500	"Inland Empire"
F	15	20	1500 to 2500	Palouse Hills
M	15	25	1000 to 2500	East of Cascades
S	(More than 20)		W. side of Cascades, above 1500 feet; E side of Cascades, above 2500 feet	Mountains

LITERATURE CITED

(1) R. G. Stone, The Distribution of the Average Depth of Snow-on-ground in New York and New England: Method of Study, *Trans. Amer. Geophys. Union*, 1938, pt. 1: 486-492.

(2) Eric Miller, Snow Cover of Wisconsin, unpublished paper presented before the International Commission of Ice and Snow, 1939 meeting of the International Union of Geodesy and Geophysics.

PIEDMONT PLAIN AGRICULTURE IN SOUTHERN CALIFORNIA

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THIS PAPER is a protest against a current geographical practice which, if continued, will eventually blight the subject and the point of view of those who call themselves geographers. I refer to a rut into which many students are pushed when they are assigned problems dealing with land use, land planning, occupance, or a region. In the last decade the geographic literature has been stuffed with dozens of studies of varying degrees of quality, in which a problem in land utilization has been presented with the aid of detailed maps. Most of the studies to which I refer follow a rigid pattern which is monotonous in the extreme and sometimes ill-suited to the problem. A more serious deficiency becomes apparent when the authors ignore the historical setting of their problem, treating their subject, as it were, as though they were taking a snapshot instead of a time exposure.

This unfortunate practice can lead to highly inaccurate conclusions. For instance, in the case of Anaheim, California, the town's entire activity is centered around the handling of citrus fruit, as I have pointed out in a previously published paper.(1) But the present conditions represent the snapshot view only, while a time exposure would show that the land use near Anaheim had experienced interesting changes. In other words, present land use is only part of the story, and I am of the opinion that the geographer's work is improperly and inadequately performed unless he investigates both present and past land uses. Only then can he reach conclusions that will be valid.

Perhaps a specific problem, small in scope, will illustrate this point. In 1923, C. C. Colby of the University of Chicago prepared a brief article which was published in 1925 under the title which heads this paper: "Piedmont Plain Agriculture in Southern California." It appeared as a short chapter in the elementary text, "An Introduction to Economic Geography," by Wellington D. Jones and Derwent Whittlesey, and should therefore be well known to professional geographers. The primary purpose of the sketch was to demonstrate the effects of certain critical temperature conditions upon semi-tropical crop plantings, with the result that the crops are banded in systematic zones. It was found that several factors caused this zoning, particularly air drainage which carried the colder air to the lowlands, stony soils near the mountains which could be planted to tree crops but not to grain, and adequate water supplies on the higher slopes. The type area which was selected was situated about thirty miles east of Los Angeles, in what is known as the Cucamonga district. Here was a broad piedmont slope, about seven miles wide, facing southward from the base of the San Gabriel mountains.(2)

Soils at the top of this piedmont slope were too coarse for good cultivation, especially in the "washes" down which the flood waters poured from the mountains to form the alluvial fans which are so characteristic of this semi-arid region. Colby found the upper part of the piedmont planted to citrus fruits almost to the mountain base at an altitude of 2,100 feet, except along the flood channels of the alluvial fans. From that altitude down to 1,000 feet was a citrus zone of "oranges and a few lemons," commonly referred to as the "frostless belt." Below this Colby found a discontinuous zone of deciduous fruits, including peaches, plums, walnuts, and figs, extending down to 775 feet. Still lower, winter frost and heavy soils

allowed only the cultivation of alfalfa, kaffir corn, and barley. Fortunately, the description of this zoning was accompanied by a rough sketch map of the area, representing one of the earliest land use studies which we have available for southern California. The boundaries of the three principal zones, as delineated by Colby, are indicated by heavy dashed lines on the accompanying Figure 1.

A recent resurvey of the area, in an attempt to bring the information down to date, produced some interesting observations. The student who visits the uppermost fan slopes today will see large and complicated rearrangements of the natural drainage channels. These are "spreading grounds" or "retarding basins" designed to allow the flood waters to percolate into the stony soil instead of running off as waste. Heavily concreted revetments and stone rip-rap work line the larger channels, to prevent the formation of new distributaries which would damage the citrus groves. In those places untouched by flood control operations, the native yucca, white sage, elderberry, and sumac still flourish, and the land is uncultivated. The few houses in this relatively unoccupied area make effective use of large cobblestones in the construction of chimneys, walks, and foundations. A few rock crushers and gravel pits may be seen, making use of otherwise worthless stones. Citriculture is feasible only on the inter-fan spaces where flood danger is least and soils are more suitable for cultivation. So much for the modern aspects of the uppermost fan slopes.

The present conditions in this zone, however, assume greater significance when the student investigates the past conditions, because only then can he realize that this part of the piedmont represents a relic landscape, almost unchanged since the first days of settlement, except for the attempts to confine the flood waters within the old channels. Most of this land was considered worthless in 1850; most of it is still worthless for cultivation, but it provides the geographer with a yardstick by which he can gauge the development of agriculture in adjoining zones.

The citrus zone, in which the principal orange is the Washington navel, or winter-ripened orange, presents a sharp contrast to the unused upper fan slopes. Here everything is ordered; in place of the thickets of native vegetation, the citrus groves are carefully planned to get the maximum number of trees into minimum space. Their welfare is watched, and they are fed, watered, protected against frost damage, and tended so carefully that there is little about them to suggest either fruit-growing or agriculture to the visitor from the east. These groves appear as artificial and unnatural in a rural region as the most complex industrial areas appear in an urban landscape.

Most of the groves have been so profitable for their owners that the houses of the district are uniformly of high quality, equipped with all the conveniences which are usually associated with urban life, and are usually occupied by their owners. The typical ranch consists of a large one or two-story dwelling house, garage, tool shed, storage shed, well rig, and reservoir. In the orange and lemon groves, standpipes indicate the necessity for irrigation. Piles of smudge pots, the new types euphemistically referred to as "orchard heaters," may be stacked under the trees during summer, or distributed through the grove in winter, one pot to each tree. Some of the best groves are now equipped with pipelines which feed the fuel to the heaters without the necessity for effort on the part of the rancher during frost threats. Most ranchers make use of some form of frost protection service, which forecasts the location of freezing temperatures for some hours in advance, and notifies them by radio, warning signals, or telephone. In parts of this zone, almost nothing can be seen but citrus trees and an occasional ranch house and well rig.

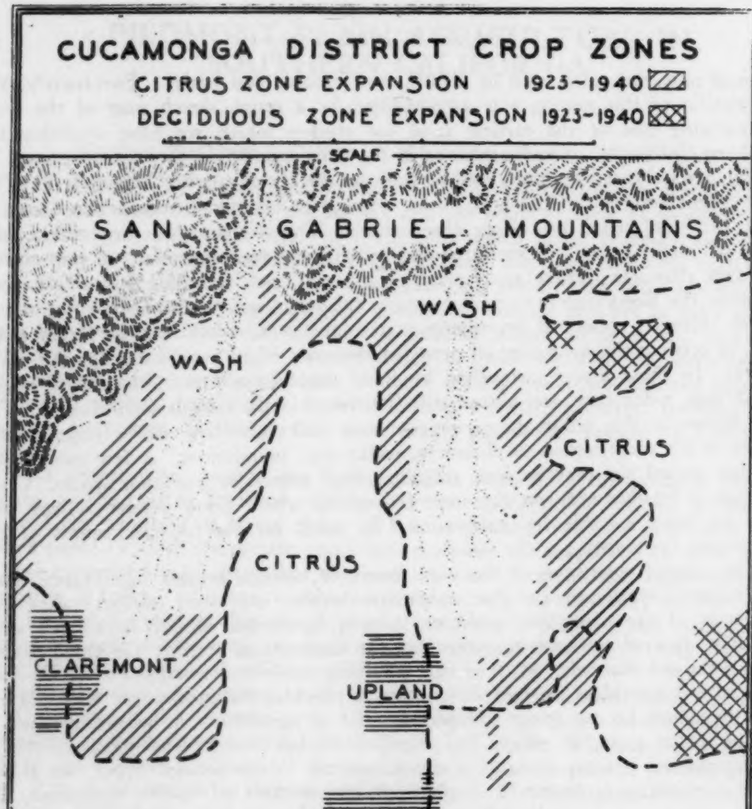
CUCAMONGA DISTRICT CROP ZONES
CITRUS ZONE EXPANSION 1923-1940
DECIDUOUS ZONE EXPANSION 1923-1940
SCALE
SAN GABRIEL MOUNTAINS
WASH
WASH
CITRUS
CITRUS
CLAREMONT
UPLAND
CITRUS
ONTARIO
GRAPES
DECIDUOUS FRUITS
WALNUTS
CHINO
HAY AND GRAIN
MIGRATORY DUNES

FIG. 1.

Kitchen gardens are rare, although every house has its lawn and flowers. Poultry houses are almost non-existent. If the ranch is in a location which suffers from high winds, the groves are surrounded by tall eucalyptus windbreaks. If it is near a "wash," the rancher may have collected the largest stones from his grove and assembled them in huge rock piles which put a New England stone wall to shame. Landholdings are relatively small, and certainly agriculture is intensive in this citrus district. These will be the usual observations of the visitor.

Now note how a simple inspection of present land use may mislead the geographer and the casual visitor alike. First, they may assume that this citrus zone has existed for a long period of time and that it represents comparatively stable land use. This is by no means the case, because a comparison of the modern map with that made by Colby in 1923 indicates an expansion of approximately twenty-five per cent in the area planted to citrus crops in the past seventeen years. Most of this expansion, as the map indicates, has occurred over the former wash areas. More water is available through pumping, methods of frost protection are improved, and markets for both oranges and lemons are wider than in 1923. This is especially true of the lemon groves. Without adequate investigation, the geographer might conclude that these groves have always been kept alive by water pumped from underground sources; but according to Colby they were watered by surface flow or "gravity water" coming directly from mountaain streams. Today these groves would quickly die if they had to depend upon "ditch water," for the distributaries on the fans are entirely dry for months each summer.

The geographical picture is not yet complete without further investigation. This land, highly productive and profitable at present, was once worthless. The Indians could not use it, except for a few springs near the mountains. It was no good to the Spaniards, except as grazing land for their cattle. The Mexicans began to use it for agriculture, by setting out a few small vineyards. Sixty years ago the owner of the Cucamonga ranch wrote:

"The lowness of the water this season depends upon several causes. First, . . . we have not had much rain. . . . Another reason is that all the surrounding country being trodden hard with sheep does not soak the rain but sheds it off thus cutting off a great portion of the storage supply for the dry season. Another cause . . . is that the mountain water is each year being more and more taken out at the foot of the mountain, evaporated by irrigation on the surface, thus diverting it from its old channels that percolate through under the plain at the foot of the mountain. . . . Still, there is enough for all stock purposes." (3)

Agriculture was only beginning to replace stock raising on this land in 1881, and it is obvious that adequate geographical treatment must include an account of the changes that occurred, and a statement giving some explanation for those changes. Briefly, the explanation involves many items, some of which are geographical, such as the decline of the cattle industry, the economic collapse of the large ranches, improvements in irrigation technique, discovery of underground water supplies, improvements in frost protection, and improvements in refrigeration of fruit while in transit to markets. The complete background would require a book instead of a short paper on the subject.

The deciduous fruit zone, lower than the citrus zone, presents some sharp contrasts. The quality of the ranch houses, for one thing, is far below that of the houses in the citrus groves. Some of them are only shacks. They, too, lack poultry sheds or kitchen gardens. The most attractive landscape in this area is that of the walnut groves, with their clean cultivation, showing brown earth under bare limbs

in winter, and dark shadows on the ground beneath dense foliage in summer. In general, the boundary between the citrus and deciduous zones has changed little since Colby's survey, but the most stable boundary defines that part of the deciduous zone which is planted to wine grapes. Landholdings vary in size, from the thousands of acres planted in grapes to the small orchards of peaches or groves of walnuts. The special reason for the grape plantings is the presence of strong foehn winds which sweep the southeastern part of the area represented on the map. They originate in the Cajon pass to the northeast, and account for excessively sandy windblown soil, which may form low dunes from four to six feet high. Water is too expensive to waste on such porous material, so that most of the grapes are unirrigated. Winds are too strong for tree fruits to ripen unburned and unblemished. In this vineyard landscape, the landowners do not live on the property, but the vineyard laborers, mostly Mexicans, live in clusters of wooden shacks. These are especially noticeable at Cucamonga, where economic conditions approach the lowest level in the entire district under discussion. Attempts to prevent excessive wind damage to the vines, and migration of the dunes, have led to the planting of large eucalyptus windbreaks along the section lines or their subdivisions. These windbreaks are characteristic features of the landscape throughout the entire eastern half of the area represented on the map. They are badly needed, for maximum wind velocities of seventy or eighty miles per hour are fairly common during the "Santa Anas" which sweep down from Cajon pass. (4) During such periods, traffic on the highways through the vineyard district is halted by the highway patrol until the wind subsides and safe driving is possible.

At the southern edge of the region, the walnut plantings give way to small dairy ranches, in which the conspicuous features are the open fields of alfalfa or grain hay. Few trees have been planted, and the houses are of the same order as those of the deciduous zone, that is, of fair to poor quality. Specialization in dairy products has been the primary function of the area near Chino for some years, and this district provides about one-sixth of the fresh milk supply of Los Angeles. It will be noted that the walnut groves have encroached upon the area of the dairy region to the extent of a seventy-five per cent expansion* since 1923, although the boundary between the two zones is not so sharp as the map seems to indicate. There is no good geographical reason for the expansion of the deciduous zone, but economic returns from plantings, in relation to costs of cultivation and water, are the essential items. Many of the older walnut groves are now being torn out, because newer thin-shelled varieties and larger nuts bring the highest prices, forcing some of the ranch owners to replant their groves or plant new acreage if they wish to compete in walnut production.

There is the present picture, but can it be more than thinly superficial without an understanding of what has gone before? In 1858, the road from San Gabriel to San Bernardino "passed for some fifteen miles through an arid desert of sand, void of vegetation, except for a few stunted sage bushes and elders."(5) Between 1870 and 1880, the extensive plantings of wine grapes were set out in the sandy soils. In 1888, the irrigation system for supplying the district near Chino was under construction, and shortly thereafter it provided a water supply for extensive plantings of sugar beets. Within ten years, there were eight to ten thousand acres of sugar beets under cultivation, supplying one of the principal beet sugar refineries in the United States, built in 1891. (6) This refinery is now being demol-

*These figures exclude the grape plantings, the boundaries of which have been relatively stable for some years.

ished, because Chino makes greater profits from dairying operations. Its ruins in the cultural landscape, however, are neither understandable nor explicable on the basis of what the observer may see in the present-day agricultural landscape alone; only a study of past land use will clarify the matter.

It has been shown that even in this small area, involving a relatively simple land use, a careful observer may be misled concerning the shifting boundaries of land use, the significance of undisturbed landscapes, or change in agricultural practice unless he has investigated past as well as present land uses. Unless he has gone into his subject far beyond the superficial stages, he may be unaware of the introduction of foreign plant varieties, and he may be unable to explain the presence of relic landscapes or industries within his area. Evidently if his work is to be performed with thoroughness, he cannot ignore the geography of the past, and it is even possible that he should not ignore the geography of the future. I plead, therefore, for re-valuation and re-emphasis upon the contributions which I feel certain the study of historical geography can make toward better understanding and appreciation of present-day conditions.

LITERATURE CITED

(1) Hallock F. Raup, The German Colonization of Anaheim, California, *Univ. Calif. Publs. Geogr.*, 6: 123-146, 1932.

(2) Wellington D. Jones and Derwent S. Whittlesey, An Introduction to Economic Geography, vol. 1 (Chicago, 1925): figs. 226-228. In these figures Colby incorrectly refers to the mountains as the San Bernardino Mountains.

(3) Richard Gird, MS diary, 2 vols., HM 2279, Huntington Library, San Marino, California.

(4) For a description and discussion of these winds, see Irving P. Krick, Foehn Winds of Southern California, *Gerlands Beitrage zur Geophysik*, 39: 399-407, 1933.

(5) "Knight" writing in *Daily Alta California*, 10, no. 72, March 14, 1858.

(6) "San Bernardino County, California," a pamphlet issued by the County Board of Supervisors, 1902.

THE CHOROLOGIC ASPECT

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A MODERN geography was altogether impossible until a little more than a century ago. From then on a succession of geographers has given us a conception of their discipline that should never be lost again. Only after the groundwork had been laid by geology, the natural sciences, and biology was it possible to arrive at what we call geography today. Men such as Vidal de la Blache, Blanchard, and de Martonne, Humboldt, Ritter, Ratzel, and Hettner have taught us how geographic research must consider all factors that help to make up the surface of this globe. In the combination of history, geology, climatology, biology, and other sciences geography affords us a means of understanding countries and their problems that is vastly superior to any other method we know today. Chorology is the crown of all geographic endeavor.

As our civilization steadily grows more complex, intensive regional studies become increasingly urgent. Perhaps we know better today than ever before how narrowmindedness and ignorance result in politics that must eventually lead to wars and destruction. It is not difficult to deal with a neighbor with whose problems we are familiar, but by failing to understand him we invite serious friction. If, therefore, chorology provides the best methods of understanding we may hope to obtain, it would seem that modern geographers should devote most of their time to it. An unbiased and detached description of all the factors of a country and how they result in creating its present conditions; such a fair picture will prove of inestimable help in the solution of cultural and economic problems on a national or international scale.

Such a picture can be painted only by first class geographers. On the other hand, geographers, on account of their training and background, have the duty of doing what others can not do: promote and invigorate the study of regional geography in schools and at home. Great masterpieces have been published, but they tower in solitude above a mass of geographic writings of limited worth. The immense educational value of linking together many fields and seeing their interrelations, as is done in chorology, is not fully realized by many of our geographers of the present day. In fact—and it is a very hard and alarming fact—so small is the production of regional studies that of all the publications discussed in the *Geographical Review* from 1917 to the present, only 7.5% are of a chorologic character, and only a fraction of one per cent are American. This situation is the more regrettable because the general standard of living has greatly risen in this country during these years, while in Europe it has either not changed or has steadily declined.

With a few shining exceptions, the American geographic world is not at all aware of its great tasks, and that in spite of the outstanding teachers who have appeared form time to time. Those great men, some of whom I have mentioned, are distinguished exceptions to the general rule. The reason for this deplorable state is twofold. The trend which our civilization has taken in the nineteenth century and thus far in the twentieth has resulted in a general deterioration of spiritual values and an enormous aggravation of materialism. In rude and coldblooded disregard of so-called higher values, man has pushed himself far into the foreground of all considerations. The resulting anthropocentric character of modern research quickly led to the degeneration of almost every scientific field into a

growing number of narrow branches. To be ever more specialized seemed the greatest achievement. But man worked as through binoculars: the more powerful the magnification became, the narrower grew the range. Economic aspects in particular have flourished, and so intense is this demoralization of higher learning that in the field of geography most of the men concerned do not at all grasp the superior importance of chorology.

The second reason is that there is widespread lack of understanding of the obvious fact that geographers require a much more intensive training than and a totally different mode of thinking from what they have received and practised. There is a great difference between following a comparatively straight line, as in most sciences, and coordinating a number of lines to make them meet. The approach of chorology starts from a different premise and follows a different course from most other disciplines. Until this is understood, we may not expect very encouraging results.

Here follows what in the opinion of a few leading geographers, picked at random, geography—or, more exactly, chorology—is. Ritter: "Geography is to use the whole circle of sciences to illustrate its own individuality, not to exhibit their peculiarities. It must make them all give a portion, not the whole, and yet must keep itself single and clear."(1) Demangeon: "Every region has its unique character to which contribute the features of the soil, atmosphere, plants, and man. The aim of geography is to synthesize these features and to show the interlocking of all the phenomena which comprise regional types."(2) Hettner: "Geography can be an independent science only as chorology."(3) Sauer: "We may say that chorologists are such geographers as place their major emphasis on the area, so as to understand increasingly its properties and expressions and to approach a unified viewpoint of the content and connection of areas in general."(4) Even Mme. de Stael, not a geographer but a literary person of rare insight, insisted: "Nothing can be wisely examined without that elevation of mind which sees the whole while it is describing the parts."(5)

It follows that geography is primarily a science of relations and coordinations. Highly specialized publications will always be most welcome. Yet it does seem that geographers today are devoting more time than is desirable to studies that are only partly or indirectly geographic. One receives the impression that many write today to get something published. Thus quality is replaced by quantity. Of course, we do not expect all geographers suddenly to write chorologies exclusively. But it would certainly raise the standard of our science if more efforts were bent in this direction. The consequences would be manifold. Less would be published, but what was published would be of higher grade. It would be recognized to a greater extent that the regions under consideration need by no means be of continental size; that even parts of a county can represent geographic units and be described as such. Already fifteen years ago the following question was raised, in lamentation but with justice: "May not our failure to acknowledge the dignity of study in the superficially familiar scene be a partial explanation for the distressingly small production of research studies among American geographers?"(10) Furthermore, capacity for and quality of teaching would be raised materially, as teachers automatically improved their thinking by adopting the broad chorologic view.

To a large extent geography has become human geography. But the overemphasis of a single factor in so complex a matter as chorology must necessarily upset the natural balance to the extent that the value of nonhuman factors is underestimated. Equilibrium of thought is not possible in a onesided geography. Ratzel

complied with the *Zeitgeist* when he wrote his "Anthropogeographie," but even he warned: "The preference of the human element is a constant danger for the scientific character of geography." (7)

Lack of acquaintance with nonhuman features may have very drastic consequences, as is shown by the war between Bolivia and Paraguay. The Bolivian troops were better trained, equipped, and financed than the Paraguayans. They swept down the Andes and into the perspiring gloom of the Chaco jungle. They were defeated less by the Paraguayan soldiers than by such factors as low altitude, high temperature, high humidity, and insects. With these allies the Paraguayans drove their enemy before them as a wolf drives a flock of sheep. But as soon as the mountains were reached, the situation was reversed: the Paraguayans were unable to master the changed topography and the war ended where the plains ended.

A too human geography, moreover, automatically neglects uninhabited areas. In the same way as botany as a science examines all plants, from the beautiful flower and the delicious fruit to the insignificant weed, so does geography consider all regions, regardless of the number of their human inhabitants. Or what is the geographic difference between two scenes, in one of which the structures are erected by man, and in the other by termites? It has not yet been openly admitted, but there is little difference between human and economic geography. The term "human" sounds more dignified; and one might argue that there is more justification for it. But this is just one way of losing one's bearings. Economic thinking, developed more magnificently in this country than anywhere else in the world, has made too great inroads into geography, and prevents our thinking from being balanced. But the economic viewpoint is only one among many. Any overspecialization warps the view. The more extreme specialization becomes, the more nearly impossible is it to keep the goal in sight. The irrigation problems of the Sacramento Valley or the settlement of Queensland by whites are important questions, but only indirectly geographic. We may calmly leave them to economists and anthropologists.

We gain by the advances in other sciences but lose again to the extent that geography is allowed to crumble into specialized fields, since such crumbling makes the peculiarly geographic approach difficult, if not impossible. In geography more than in other sciences it is dangerous to particularize, since particularization is directly opposed to coordination, the main purpose of geography. Failure to be comprehensive leads to shallowness more quickly in geography than elsewhere. *The profoundness of geographic thought depends on its inclusiveness.*

Overemphasis of the material side of geography calls for a few remarks concerning those elements which cannot be expressed in mathematical language. "A good deal of the meaning of area lies beyond scientific regimentation. The best geography has never disregarded the esthetic qualities of landscape. To some, whatever is mystical is an abomination. Yet it is significant that there are others, and among them some of the best, who believe that, having observed widely and charted diligently, there yet remains a quality of understanding at a higher plane which may not be reduced to formal process." (8) Indeed, Alexander von Humboldt found it impossible to separate artistic experience of nature from scientific research. "The laws of physics which the scientists regard as unbreakable do not govern everything in the universe, as most people seem to think." (9) There are life forces which cannot be condensed into formulas, and this *élan vital* evokes strong resonance within ourselves.

Who knows what a landscape intrinsically is? Every landscape lives differently,

hence receives an impression of life different from that received by any other. Therefore our own reactions change with the landscape. Ignorance leads to superstition, but knowledge, too, has its two sides. We see today how easily it leads to materialism. Familiarity breeds contempt. Veneration and respect vanish. Lost is the appreciation of the wonders which for our spiritual life is so indispensable and without which we are finally led to the attempt to reduce nature to mathematical equations. That reduction is, however, impossible, and the attempt to perform it leads to confusion. We know today why flowers open in the morning and close at nightfall. We know today why water freezes first at the top of ponds and lakes and thus preserves life. But does our knowledge make these marvels less marvelous? It makes little difference whether we speak of the soul of the landscape or of its mysterious force. We must nevertheless admit its existence. It betrays itself in the temperament of the people, the flavor of its fruits and wines, in history, and in innumerable other ways. For this reason a geagrapher must live in the region he wishes to describe. Unless he does so, he will never grasp its most important characteristics, but will instead enumerate the observations of others, coupled perhaps with intellectual conclusions. The most basic and simple expressions of a region are also the most difficult ones: their simplicity consists in much that can not be said, and need not be said, because the people of the region understand those things instinctively. For this reason they remain inaccessible to the stranger. (10) The aroma of the landscape is neither exactly definable nor measurable, but just so much the more significant. "By scientific methods we can only prove for the intellect afterwards, by means of intelligence and communication, what was already proved for the soul in the moment of revelation." (11) We have to be a part of the surroundings, live with them, feel and suffer with them, before their soul is revealed to us. But to explain the soul by exact science is foolish. It is most significant that the *"Handbuch der geographischen Wissenschaften"* is illustrated with paintings. Humboldt's artistic approach cannot be ignored. The beauty of the landscape is an important feature of its soul. It inheres in combinations. *"Vedi Napoli e poi muori,"* exclaims the Italian. But it is not the city of Naples nor Mount Vesuvius that is so beautiful; it is the combination of both with the bay and the islands and the colors of land, sea, and sky. How many geographers are colorblind to the extent that they overlook colors altogether! The great life forces function in such marvelous way that we must stand in awe and eternal amazement. Only in that spirit of awe and amazement can we apply our observations in such a way as to reach our goal. Where there is mind only and no heart, achievement must forever remain incomplete. To borrow symbols from music: geography approached in the spirit described becomes a *tema con variazioni*, becomes *contrapuntal*, and thus reaches its greatest heights. Viewed from this angle, opportunities and tasks for geography are revealed that have never yet occurred to anyone.

There is another viewpoint that is too frequently neglected: the history of the landscape. Human history is rooted so deeply in the history of the landscape that unless that history is known the life of its people cannot be understood. In most instances, recent changes in the landscape have been due to activities of man. We read of buffalo herds and Indians and millions of passenger pigeons in the Mississippi Valley. They have all vanished. Jungle countries such as Jamaica and Java have been transformed into vast plantations. This historical development is of particular importance, since the landscape must be viewed as alive. All things that are alive, however, change continuously, new forms evolving from older ones.

The whole earth is alive. To a large extent geography is the biography of the landscape, and most certainly not a snapshot taken at the moment of observation.

Both geography and its object, the landscape, have developed through many stages; and it is this growth and metamorphosis, these ever changing tides, that must be borne in mind in all geographic considerations. Goethe was perhaps the first man to realize this necessity. His living world was first of all an organism, a being, and one understands that the results of exploring it, even if they are couched in physical terms, do not aim at numbers nor laws nor causalities squeezed into formulas. In archaeology and history we view the past of man; geology and paleontology throw their light on the past of nature. Science explains the laws and facts that surround us today. As a combination of history and science, geography will give us a complete picture of the landscape. However heterogeneous its character may be, fundamentally geography is the union of science and art, of intellect and intuition.

We come to our conclusion. Through the course of time the meaning and importance of geography have changed. It has gradually developed into its present state, in which it appears most perfectly as chorology. The axiomatic condition for any chorology is an unbiased description of the landscape, based on facts. "In such descriptions man and beast are mentioned only in so far as they have exercised an influence on the landscape or find some visible expression." (12) From this position the observer must be led to an intimate acquaintance with all expressions of life in the region, whether they are somatic or not. The situation today is more encouraging than it has ever been before. The goal is clearly defined and great leaders have given us the tools to work with. It remains to use those tools creatively.

LITERATURE CITED

(1) Carl Ritter, Comparative Geography (Philadelphia, 1865):xxviii. Cited in R. E. Dickinson and O. J. R. Howarth, The Making of Geography (Oxford, 1933): 152.

(2) A. Demangeon, Vidal de la Blache, *Revue Universitare,* 27(2):4-13, 1918. Reference to p. 4. Cited in Dickinson and Howarth, *op. cit.*: 234 235.

(3) Alfred Hettner, Methodische Zeit- und Streitfragen, *Geogr. Ztsch.,* 29: 37-59, 1923. Reference to p. 37. Cited in Carl O. Sauer, The Morphology of Landscape, *Univ. Calif. Publs. in Geogr.,* 2: 19-54, 1925, on p. 21.

(4) Carl O. Sauer, Recent Developments in Cultural Geography, *in* Recent Developments in the Social Sciences (Philadelphia, 1927):154-212. Reference to p. 177.

(5) Mme. la Baronne de Staël-Holstein, De l'Allemagne, 3 (Paris, 1810, repr. Londres, 1813): 127.

(6) Carl O. Sauer. The Survey Method in Geography and its Objectives, *Ann. Assoc. Amer Geogr.,* 14: 17-33. 1924. Reference to p. 32.

(7) Friedrich Ratzel, Anthropogeographie, 1 (ed. 4, Stuttgart, 1921): 51.

(8) Carl O. Sauer, The Morphology of Landscape, *op. cit.*: 48.

(9) Gustaf Strömberg, The Soul of the Universe (Philadelphia, 1940): 230.

(10) Cf. Oswald Spengler, Der Untergang des Abendlandes, 1 (München, 1922): 109.

(11) *Ibid.,* 2 (München, 1923): 56.

(12) Siegfried Passarge, Beschreibende Landschaftskunde (Hamburg, 1929): 2.

The Association of Pacific Coast Geographers

SIXTH ANNUAL MEETING: PROGRAM WITH ABSTRACTS OF PAPERS PRESENTED

THE SIXTH annual meeting of the Association was held at the University of Washington, Seattle, on June 20, 21, and 22, 1940. Six sessions for the presentation of papers were held, at which a total of 29 papers were read. In addition to these, two addresses, besides a summary of the address prepared by the retiring president, Peveril Meigs, who was unable to attend, were read at the annual dinner on Friday evening, June 21. The newly elected officers for 1941 were also announced at this session.

The following are the titles of the papers presented, with abstracts of those submitted to the editor in full or in abstract, and that are not published in full in the foregoing pages:

Thursday morning session, June 20:

Studies in the Urban Geography of Portland, Oregon. Norman Carls, Eastern Illinois Normal, Charleston, Illinois.

Abstract: The natural basis of a commercial crossroads exists where the Columbia River intersects the Puget Trough. Man improved the channel from Portland to the sea, built the land routes through the narrow Columbia Gorge, and improved the channel of the river for shipping. The Gorge, which gives Portland the largest "natural" trade area of the four major Pacific ports, is the Oregon city's greatest resource. A broad highway and a thirty-foot river channel to The Dalles will soon link Portland with the trade of the "Inland Empire." Current improvements of the channel have revived traffic by river barges, and it is hoped that that traffic will reduce hauling charges of land carriers.

Portland won commercial supremacy in the lower Columbia Valley during the early pioneer period in competition with other towns. Its victory resulted from factors now unimportant; commerce of the present day might prefer a different focal point. The city feels pulls both eastward and downstream. Were Portland to grow measurably as a regional metropolis, the commercial nucleus would probably shift to the point east of the Willamette where the center of population of the city lies, and where the important land routes converge. Were foreign trade to grow greatly, Portland would feel strongly the pull downstream toward the broad, quiet channel near the mouth of the Willamette that is readily accessible to barge traffic on the upper Columbia. The growth of Vancouver is rightly a matter of concern to the larger city.

Any growth Portland attains will be slowed to the tempo of its conservatism The advantages favoring its growth are a situation near the natural crossroads of the rapidly developing Northwest and the momentum given it by its commercial position as one of the two metropolises of that region.

Factors in the Growth of Everett, Washington. Leda Hamilton, University of Washington, Seattle.

Abstract: Everett has a population of 30,000, and ranks third among the cities on Puget Sound. It is first among these cities in the production of lumber and wood products. Several factors contribute to this high rank: The city is situated in an area once rich in timber. Most of the accessible supply of timber is exhausted from the immediate vicinity of the city, but this circumstance has led to the concentration of mills in the city at tidewater. Its peninsular site at the mouth of the Snohomish River gives it a large waterfront on the Sound, with an excellent deep water harbor. Such a site is advantageous to mill operators because it affords cheap transportation that facilitates both receipt of towed logs and shipment of finished products made from them. Finally, there is abundant storage space for logs and plenty of fresh water.

The better grades of fir and all grades of cedar logs are used in the manufacture of veneer and plywood, shingles, rough and finished lumber, sash and door work, and burial caskets. The woodpulp and paper industry is a comparatively recent development, but has a promising future: Everett ranks first among Pacific coast cities in number of board feet of timber made into pulp. The Weyerhaeuser

Timber Company, one of the largest corporations of its kind in the region, operates two lumber mills and one pulp mill in Everett, a nucleus that assures the city a place in the future of the industry.

Other industries and trade are favored by Everett's being the county seat and largest town in Snohomish County and serving as market and shipping point for agricultural produce from its immediate hinterland. It is on the main United States arterial highway that crosses the state from north to south, and is the western terminus of the shortest highway route from the East. It is the point at which the Great Northern railway first reaches tidewater. Although Everett ranks third among Puget Sound ports, the source of outgoing and the destination of incoming shipping are the mills. The future development of Everett will be limited by its proximity to Seattle (within 28 miles), since the larger city attracts industry and trade through its superior facilities; and by the narrow basis of its industries, which rest on only one rather than on many resources.

Industrial Tacoma. Gertrude L. McKean, University of Washington, Seattle.

Abstract: Tacoma, with a population of 107,000, is situated on tidewater near the northern end of the Puget Sound lowland. Its economy is characterized by four types of industry: woodworking, food processing, metals and machinery, and chemicals. Because of easy access to raw materials and transportation by water, Tacoma has become a center for the manufacture of a wide variety of wood products: lumber, shingles, millwork, plywood, doors, furniture, wood pulp, wood flour, cabinet work, novelties, and toys. While lumber production has declined in recent years the output of plywood, pulp, and novelties has increased. Flour milling and meat packing are the most important food processing industries, their raw materials coming from eastern Washington, Oregon and Idaho. Unlike flour, which goes into world trade, nearly all the meat products are marketed in western Washington. In addition to these main products, many specialties, such as relishes, potato chips, and ice cream, are made. Tacoma is a center for the distribution of soft drinks, and also manufactures beer and wine.

The two electrochemical industries, the only ones in the Northwest, are situated in Tacoma largely because of the low electric power rates that are available. A large share of their output is consumed by the pulp and paper industry of the Northwest. The smelter is an integral part of Tacoma's industrial equipment, handling gold, silver, and copper ores. The output of gold and silver is relatively small, but one tenth of all the copper refined in the United States is refined here. Ninety per cent of the ores used are from foreign sources. In addition to the long established small pleasure and fishing boat industry, a shipyard making large Diesel motored cargo vessels was reopened in October, 1939, and expansion of its production is expected soon.

The City of Fresno. Elizabeth Schreiber, Fresno, California.

Abstract: Fresno, California, is an outgrowth of the richly productive agricultural hinterland of which it is the center. Before the development of an extensive irrigation system, the San Joaquin Valley was a vast expanse of desert and steppe. Today its central part is one of the most prosperous regions in the United States. The city itself was established as a station on the route of the first railway through the Valley. From a railway station on a bleak, arid flat, the city has grown to be a community of some 80,000 people. The climate of the central Valley is ideal for the raisin grape, production of which is the dominant industry of the region. Raisin grapes, wine and table grapes, peaches, small and subtropical fruits, cotton, grains, and dairying form the basis of the economy of the hinterland of Fresno. Fruits are grown on small ranches of twenty acres or more, many of which are parts of original colonies by means of which this part of the Valley was settled.

Processing and distribution of the products of its hinterland are concentrated at Fresno. Eighty percent of its industries are based on agriculture. Here are found the world's largest raisin packing plant and many other packing houses and canneries which pack and ship the fruit crop. A number of wineries in or near the city produce millions of dollars' worth of wine each year. Cotton is ginned near the city, and the conversion of cotton seed into various products is a growing industry. The larger part of the area of the city is occupied by residences. The commercial district occupies an area trending obliquely to the cardinal directions

which was the site of the original town plat oriented with respect to the railway. The manufacturing district lies on the southern and southeastern edge of the city.

Tri-functional Urbanization at Grand Coulee Dam. Harold E. Tennant, Seattle, Washington.

Abstract: When construction began on the Grand Coulee power and irrigation project in the fall of 1933, hundreds of people flocked to the site. Job hunters, business prospectors, and seekers after adventure produced a modern version of the Klondike gold rush. This mixed population has been sifted, and three distinct urban groups have emerged, each localized by its special function in the construction of the dam.

The nucleus of the tri-functional urbanization of the vicinity of the dam is the carefully planned and expensively constructed town of the Federal engineers, called "Coulee Dam." It is a permanent settlement, intended to house the operations and maintenance staff of the Reclamation Bureau after construction is completed. It is not at present economically self-sufficient. A definite social stratification exists in the community, that reflects the hierarchy of Civil Service ratings.

Mason City, the camp site of the principal contractor, ranks second from the viewpoint of planning and quality of construction. Here the profit motive has been the dominating influence. Mason City is self-sufficient and cosmopolitan. Its population is composed largely of specialists in construction who have traveled widely, following construction jobs, and who comprise a sophisticated social group unfettered by prescribed governmental policies or regulations. Mason City will be obliterated when the construction operations are completed, and its site will revert to the desert.

The mushroom towns of the boom belt crowding the edge of the government reservation present a picture of temporary confusion. They serve a threefold purpose as commercial centers, dwelling places for the overflow from the other two towns, and foci of recreation. Their populations contain four types: ethical business and professional people, the overflow of skilled, semiskilled, and unskilled workers from the other two towns, impoverished farmers from nearby areas, and itinerants. When construction is completed, these towns, too, will fall into decay as quickly as they have grown.

Development and Possibilities of an Alaskan Livestock Industry. W. T. White, Soil Conservation Service, Spokane, Washington.

Abstract: The first introduction of domestic livestock into Alaska occurred 150 years ago, when cattle were imported from Russia and distributed to several Alaskan settlements. Records indicate that these cattle showed a profitable increase only on Kodiak Island. The interest of the United States was not sharply focused on Alaska until gold was discovered on both sides of the Alaskan-Canadian boundary in 1896. Cattle, sheep, swine, and poultry were shipped to Alaska to support the miners and settlers throughout the period 1898 to 1910. Since that time there has always been some local production of livestock and livestock products.

The United States Department of Agriculture established a number of agricultural experiment stations during the thirty-five year period following the gold rush. These were located at Sitka, Copper Center, Rampart, Kenai, Fairbanks, and Matanuska. Livestock problems were investigated at the stations at Kodiak and Matanuska. Hardy breeds of beef cattle, sheep, and swine have been found suitable for limited parts of the Territory. The aggregate area of Alaska adapted to livestock, though only a small percentage of its total area, offers considerable promise for this resource, if it is properly developed. The tundra of northern and western Alaska is well adapted to the production of reindeer. Southwestern Alaska offers the best possibilities for the raising of beef cattle and sheep. Matanuska Valley and the nearby Kenai Peninsula appear to be best suited to dairy cattle, swine, and poultry. The Fairbanks district of the Tanana River valley and the panhandle of southeastern Alaska can profitably supply their local needs for dairy products and swine. Hay, silage, and cereal grains can be successfully grown locally and supplements to native range and seeded pastures in the more important agricultural regions of Alaska. The full development of the livestock industry in the Territory awaits only the wider expansion of mining, lumbering, fishing, and

manufacturing, and the coming of more experienced and capable ranchers and farmers willing to face the prevailing pioneer conditions.

Thursday Afternoon Session, June 20.
The Chorological Aspect. A. W. Küchler, Santa Barbara, California.
(Published in full in this issue.)

Rock Streams in the Sierra Nevada, California. John E. Kesseli, University of California, Berkeley.

Abstract: Rock streams, also termed "rock glaciers," are tongue-shaped accumulations of rubble and blocks that have been observed in the mountains of Colorado, Wyoming, and Alaska, and in the Alps. Several explanations of their origin have been advanced. In the United States they are most frequently interpreted as deposits of landslides or as resulting from creep of landslide deposits or talus. The creeping of rock streams has been proved and measured only by André Chaix, who studied a group of them in the Swiss National Park. In spite of establishing the creeping movement of these tongues of rubble and blocks, Chaix clearly realized that creep could not account for their formation; and he was able to show that they are deposits of glaciers still in existence at the beginning of the last century, but which have vanished since that time.

The study of 76 rock streams of the Sierra Nevada, situated in eight valleys of its eastern slope in the vicinity of Mono Lake, revealed that not one of them is the result of a landslide. On only one of the 76 examined is creep probable, and creep alone can not account for its existence. All the other streams consist of blocks too large to permit creeping.

The valley of Sherwin Creek harbors 15 rock streams. The adjoining valley of Laurel Creek, which is of similar size, contains only three. The bedrock of Sherwin Creek is a granodiorite with widely spaced joints, which weathers readily into large blocks up to twenty feet in their longest dimensions. Further reduction of these blocks through weathering is, however, very slow, since further assistance by joints is lacking. The metasediments of Laurel Creek are very closely jointed and disintegrate readily into rubble and sand. The relative frequency of rock streams in the two valleys is therefore clearly related to their lithology.

The valley of Laurel Creek contains ten terminal moraines of recessional stages of the Wisconsin; the valley of Sherwin Creek none. A comparison of the rock streams on Sherwin Creek with the terminal moraines on Laurel Creek demonstrates that the former correspond in situation, elevation, and relative volume to the latter. The rock streams of Sherwin Creek are thus obviously also of glacial origin. This interpretation was found applicable to all other rock streams investigated.

(This paper will be published in full in a forthcoming issue of *Geographical Review.*)

The influence of the Canadian Selkirks on the Westward Movement. Joseph T. Hazard, Seattle Public Schools, Seattle.

Abstract: The early settlers of the Pacific Northwest came across the Plains, by way of the Isthmus of Panama, around the Horn, or by way of China and the Hawaiian Islands. A fifth approach that would have been the earliest and might have been the most important both in the settlement and in the political history of the region was blocked by the Selkirk Range of British Columbia. Great Britain had the first and fullest information concerning heavily forested, fertile lands along the northern Pacific coast of North America. The Revolution, thwarted Britain's ambitions for land in the New World. The northern fur trade had led from Winnipeg to the many rivers reaching westward to the Pacific. Then the approaches farther south were closed by the Louisiana Purchase, so that a potential British "Westward Movement" was forced into the valleys of those Canadian rivers. It is logical to conclude that the prompt opening to settlers of a route to the upper Okanogan Valley and onward to the Pacific coast would have promptly led to an impressive movement of population to occupy these lands. The Canadian Rockies offered four usable southern routes for men and horses, and, given pioneer resourcefulness, for wagon trains. But up to the present no wagon road has yet been able to penetrate the Selkirk Range, the barrier west of the southern Canadian

Rockies.

There are no passes through the Selkirks. The Canadian Pacific Railway forced its way through them by means of gigantic snowsheds and modern tunnels. The valleys of the range are narrow and precipitous canyons, and are not connected with each other, either east-west or north-south. The history of the settlement and political control of the Northwest would undoubtedly have been greatly different if this barrier to westward migration through Canada did not exist.

The Range Cattle Industry of Northwestern Colorado. Kay DeKraay, Aberdeen, Washington.

Abstract: The range cattle industry of northwestern Colorado began between 1880 and 1885 in the coöperative grazing of the open range by homesteaders in the Yampa Valley and its tributaries. Herds were of only moderate size, and were grazed in a system of transhumance between the "lower" and "upper" country of Moffatt and Routt Counties. At about the turn of the twentieth century larger individual enterprises became common.

Between 1908 and 1914 the Denver and Salt Lake Railroad was built into the region, and brought dry farmers into it. Their arrival led to the enclosure of the open range and water holes. A further restriction on the range cattle industry was introduced by the establishment of a national forest in the "upper country" in 1906. The incursion of sheepherders from Wyoming and Utah, under grazing permits, into the higher parts of the forest provoked competitive introduction of sheep by the cattle men of northwestern Colorado. The postwar depression led to the bankruptcy of many of the cattle ranchers, and their home ranches were bought by sheepherders, who were able to survive economically under conditions that ruined the cattle men. Sheep had definitely taken the lead over cattle by 1930. Under the conditions of scanty precipitation in the western part of the region, the introduction of sheep has led to decided overgrazing, with its consequences, ruin of the plant cover and accelerated erosion of the soil.

Historical Geography of the Rogue River Valley. Willis B. Merriam, Oregon College of Education, Monmouth.

Abstract: The first white men in the Rogue River Valley were French Canadian trappers and fur traders in the employ of the Hudson Bay Company. Returns from trapping in this area were never great, however, and so the Company abandoned its post at Fort Vancouver in 1846. In the trapping period the Valley was used occasionally as a passageway through which a few pioneers from California or from the East traveled on their way to the Willamette. The experiences of an expedition, undertaken in 1846, in search of a satisfactory land route connecting California and the Willamette were so discouraging that such a route was judged impracticable. In an effort to shorten the distance from Fort Hall to the Willamette, the South Immigrant Road was put through in 1846 from Twin Falls to Klamath Falls, across the Cascades into the Rogue River Valley, and then northward. This effort was successful, and the Valley became a regular immigrant route for a year or two.

The powerful incentive provided by the discovery of gold in California in 1848 made the trail southward from the Rogue River over the Siskiyous, pronounced impracticable in 1846, the easiest path to California. Shipment of foodstuffs overland to California by way of the Rogue River Valley from the Willamette began almost immediately. Two drivers on this route discovered gold near Jacksonville in 1851, and thus started a minor gold rush into southwestern Oregon. Farmers came in to supply the local market, and the settlement of the Valley was under way. Unlike many agricultural supply centers for the boom towns of the gold rush period in the West, the Rogue River Valley did not suffer materially as a result of the decline of the placers after 1864. A sufficiently solid economic base had already been laid to keep the region on something better than a subsistence level until transportation and irrigation permitted the Valley to assume the economic pattern that characterizes it today.

The culture pattern that now dominates the region is founded on the railways that were first built into the Valley in 1887, an integrated irrigation system established in 1906, the influx of eastern investors in pear orchards in 1908, and the completion of the Pacific Highway and other roads through the Valley since 1914.

A Physical and Economic Geography of Oregon. Warren D. Smith, University of Oregon, Eugene.

Thursday Evening Session, June 20.

Regional Planning in the Northwest. Richard G. Tyler, University of Washington, Seattle.

Piedmont Plain Agriculture in Southern California. Hallock F. Raup, Eastern Washington College of Education, Cheney.
(Published in full in this issue.)

Heat Inventory for Agricultural Purposes. Robert W. Pease, Los Angeles, California.
Abstract: Temperature is related to the growth of crop plants in two ways: first, in relation to the temperature tolerance of the plant; and second, in relation to the amount of heat required to bring it to maturity. Although there has been much investigation of the former relation, little is known concerning the latter, and comparative data of potential use in mapping the effectiveness of temperature have not been worked out. Earlier methods of heat summation have not taken into consideration the individual reactions of varieties of crop plants to differences in temperature, and consequently the efficiency of their use of heat. If the reaction of the individual variety of crop plant to differences in temperature is known, temperature values may be converted into units of growth that are not directly units of heat summation, but rather measures of the effect of accumulated heat. The unit suggested here is the "maximum growth hour," the amount of growth made by the crop in one hour at an optimum temperature. Growth at other temperatures may accumulate to produce a standard growth unit related to temperature. On this basis the effectiveness of the heat available to a given crop at any site may be determined from standard climatologic data, so that mapping may be extended to any area from which such data are available.

The first step in determining the number of maximum growth hours necessary to bring a given crop to maturity is laboratory and field experimentation conducted with the purpose of finding the reaction of growth of the plant to temperature. With this information, the second step is a comparison of the temperature régime of an area where the crop is grown with reasonable success with its phenologic dates.

I have made such a comparison, using Acala cotton growing in the Great Valley of California. The number of maximum growth hours required to mature the crop was calculated for Bakersfield. A comparison of the available effective heat provided in the period between planting and killing frost showed that this variety is well adapted to the area about Bakersfield. Corresponding calculations based on data from Chico indicated a reason why this variety is not satisfactory in the northern part of the Great Valley. At Chico the plant has an insufficient number of growth hours to mature, on the average, more than one half of the crop before the first killing frost.

The "Chitemene" System of Northeastern Rhodesia. N. F. G. Davis, University of British Columbia, Vancouver.
Abstract: The "Chitemene" system of northeastern Rhodesia is a type of shifting cultivation in which small areas of scrub forest are cleared and cropped for a short time and then abandoned. Patches of forest are cleared by felling the trees and piling the slashings in the center of the clearing. The slashings are then burned and the crop is planted in the resulting mixture of earth and ash. Only one good crop of grain is taken off the plot, but it is used the second year for other crops. Then it is abandoned and a new one cleared. About ten acres of forest are required to make one acre of garden, and it is 20 or 25 years before the forest is again ready for use. The natives occupy a village site only so long as their garden plots are not too far distant; every four or five years they move the village to a new site.

This system maintains only a low density of population. It is, however, a shrewd adaptation to the conditions of the plateau of Northern Rhodesia. The addition of ash improves the productivity of the naturally infertile soil, and

burning sterilizes it by killing weeds and insect pests. Only small patches are under cultivation at any one time, and most of the land is protected by forest from sheet wash and gullying. In a region subject to heavy tropical downpours, the importance of a system of agriculture which reduces soil erosion can not be overestimated. The future agricultural system of Northern Rhodesia may reasonably be an adaptation of the "Chitemene" system that would give more stability to village life and increase the yield of crops.

Geography of Karafuto. Howard H. Martin, University of Washington, Seattle.
Abstract: The economy of Karafuto is at present based mainly on the exploitation of timber and the manufacture of wood pulp. Since timber is being cut rapidly and 100 to 125 years will be required for reproduction of the stand, Karafuto is obviously faced with a gap in its cycle of exploitation after the virgin stand is gone. Fishing is of secondary importance and is declining rapidly. No minerals of any consequence are being mined.

The efforts of the Japanese government to develop agriculture by encouraging colonists have not been entirely successful. Of the 30,000 persons who have entered Karafuto since 1904, about one third have become discouraged and returned to southern Japan, one third have changed to occupations other than agriculture, and only the remaining one third have made a successful adjustment to the frontier environment. Migration northward is not a solution of the Japanese problem of population. Agriculture in Karafuto is increasing slowly, but it is doubtful that it can ever rise above the level of sheer subsistence.

Friday Forenoon Session, June 21.

Type Curves and Duration of Snow Cover in Washington. P. E. Church, University of Washington, Seattle.
(Published in full in this issue.)

Geography of Pend Oreille County, Washington. Ernestine Hamburg, Public Schools, Longview, Washington.
Abstract: Pend Oreille County is situated in the northeastern corner of the state of Washington. Relief permits easy communication only toward the south. All patterns of settlement, railways, and highways trend north-south, converge at Newport, the county seat, and lead thence to Spokane.

Timber still furnishes the largest part of the income of the county's inhabitants. The timber industry is, however, declining, for several reasons. Most of the stands of merchantable timber are now in National Forest, and under forest management can supply only a small yearly cut. There is an age deficiency of 35 years in the standing timber, so that cutting must decline unless the trees are to be cut before they are mature. A plan of sustained yield after the age deficiency is made up will, however, provide a large and constant timber supply and prevent the recurrence of periods of depletion of mature stands.

Economic activity can be maintained at its present level only by use of resources other than timber. Only 6,700 horsepower of a potential 420,000 horsepower of the county's water power is developed. The rest will remain unused unless a large market comes into existence to which power can be profitably transmitted. No prospective expansion of cement manufacture is visible. There may be some possibility of expansion of production of metals. In 1938 the county ranked first among the counties of the state in production of lead and zinc, third in production of lode silver, and a poor twelfth in production of placer gold. With the decline of lumbering, the inhabitants who have remained have turned to small scale agriculture. Expansion of agriculture will, however, require the solution of urgent problems of clearing, draining, and diking of the land.

Physiographic Divisions of the Columbia Plateau. Otis W. Freeman, Eastern Washington College of Education, Cheney.
(Published in full in this issue.)

Agro-geographic Adjustments in the Wenatchee Valley. Howard Pepke, Wenatchee, Washington.

Abstract: Formerly highly specialized in the production of apples, the Wenatchee Valley is at present undergoing a difficult process of readjustment in use of the land. At present the number of bearing apple trees amounts to no more than 60% of the number bearing in 1919, when production of apples in the valley was at its peak. Over 60% of the land denuded of its orchards is in no crop at all.

Originally the soils and climate of the area were extremely favorable to the production of apples. The decline of the industry has been brought about by simultaneous changes in both economic and physical circumstances. The management of many orchards was unduly expensive, so that the enterprises were profitable only when production was high and prices good. In time, the originally productive soil declined in fertility. With the aging of the orchards, insect infestation increased, entailing increasing expense for spraying. Declining prices and yields made profits impossible for most producers in the depression years. Costs of transportation to markets in the East, that could be borne when yields and prices were high, became intolerable under less favorable circumstances. Tightening of restrictions on spray residues on fruits hampered the heavy spray programs required for the control of insects. An increase in consumption of oranges limited the demand for apples.

The problem of use of the land from which the apple orchards have been removed remains unsolved. The market value of the land has fallen disastrously, and many former apple growers have left the region. Demands for other fruits than apples are satisfied by production in more favorably situated regions. Accumulated arsenic in the soil has made it toxic for many plants. The apple growers do not have the experience required for a change to other specialized fruit crops. Readjustments that are being made painfully and as yet tentatively are in the direction of diversification of crops combined with increased efficiency in the management of such apple orchards as may survive.

The Range Sheep Industry of Kittitas County. R. M. Shaw, Central Washington College of Education, Ellensburg.

Abstract: Kittitas County presents a typical view of the range sheep industry of the state of Washington: within its boundaries all kinds of feeding areas needed by range sheep are found, and the necessary facilities for transportation are provided by highways and two transcontinental railways.

The industry centers about the ewes that produce wool and lambs. In order that they may have suitable forage at all seasons, they are moved from place to place within the county in a yearly cycle. Most of their winter ranges are on the Columbia slope. In February they are herded into corrals for lambing. At the approach of summer, ewes and lambs are trailed to a shearing camp on a state highway. After the shearing, the sheep are turned toward the summer ranges in the national forests of the mountainous parts of the county. There the herder moves his band of sheep from one feeding area to another within a supervised allotment. In July the band is trailed down to a corral on a forest highway, where the "top" lambs are separated out and sent by truck to Seattle or are driven to the nearest railway stockpens for shipment to the East. The remaining sheep return to the feeding areas until fall, when the band is moved to the irrigated pastures of Kittitas County, where the lambs and defective ewes await a good market price. Rams are placed with the remaining and replacement ewes for breeding. The cycle of the year is completed when the ewes are taken to the winter ranges about November 1.

The cultural forms associated with the activities described are shiftlessly picturesque rather than impressive by their permanence. Corrals are quickly built in any suitable pattern by wiring wooden panels to posts. Sheds, unpainted and weatherworn, stand in various stages of dilapidation; and the dwelling of the herder is a canvas-covered wagon, a tent, or a shack. Though it involves the use of thousands of acres of land in all parts of the county, the imprint of the industry is but lightly stamped on the landscape. One is scarcely aware of its presence except when the sheep are on valley pastures. The industry is, however, important in the economy of the region. Besides the employment it provides directly, it offers a market to the local farmers for grain, hay, and fall pasture, and to merchants for equipment and provisions.

Friday Afternoon Session, June 21.

Changes in Land Use in the Pullman-Moscow Section of the Palouse Wheat Area. Harold H. Rhodes, Washington State College, Pullman.

Abstract: The Palouse wheat country, in the approximate center of which the towns of Pullman, Washington, and Moscow, Idaho, are situated, is the eastern part of the subhumid wheat area that extends from southeastern Washington into Idaho. The Palouse consists of steeply rolling land of deep loessial material. The northern and northeastern slopes of the asymmetric hills are steep, and have been severely eroded by rainwash and the melting of drifted snow. The climate is semiarid to subhumid. Only 19% of the annual precipitation falls during the principal months of the growing season, May to August inclusive. The harvest months, July and August, are dry. The growing season averages 155 days, but there are many local variations. The original vegetation consisted of grasses and leguminous plants, the principal grasses being bluebunch wheatgrass (*Agropyron spicatum*), big bluegrass (*Poa ampla*), Idaho fescue (*Festuca idahoensis*), junegrass (*Koeleria cristata*), and Sandberg's grass (*Poa secunda*).

Settlement and exploitation of the rich grassland of the Palouse began in the early 1870's. Settlers found the land well suited to livestock and wheat. With the improvement in transportation provided by the building of railways in the early eighties, agriculture became specialized in the form of production of annual crops of spring wheat. The inevitable decline in the productivity of the land under such treatment led to the practice of fallowing the land in alternate years. Further destructive practices were introducd after the war of 1914-1918, conspicuously tillage of the soil by implements drawn by tractors and the burning of crop residues. Progressive loss of soil by blowing and washing was added to the physical and chemical deterioration that had long been in progress.

In recent years the efforts of the Soil Conservation Service have brought about changes toward a more conservative use of the land, and these changes are reflected in the landscape. Fallowing is being discontinued. Badly washed surfaces and steep slopes are planted to permanent grasses. Trees and shrubs are planted in woodlots and windbreaks. Hay crops are being introduced into crop rotations much longer than those used in the past, and with them livestock is becoming more prominent. These new practices offer the possibility of reattainment of a balance that was disturbed long ago by the introduction of spring wheat as a single crop.

A Study of Vashon Island. Chester F. Cole, Seattle Public Schools, Seattle, Washington.

Abstract: Vashon Island, situated in Puget Sound just off the mainland between Seattle and Tacoma, is in part a summer vacation resort, but is mainly agricultural. Most of the farms of the island have areas between five and forty acres. Many are operated by Japanese tenants. In general, the inhabitants obtain a meager living from the land. A few of the islanders derive income from work in Seattle or Tacoma or from fishing. An additional source of income is provided by vacationists, who employ the permanent residents about their property and purchase supplies from local farms and stores.

The White River Valley of Washington. W. Ross Pence, Seattle, Washington.

Abstract: The White River Valley lies just south of Lake Washington, in a glacial channel oriented in a north-south direction. Though its floor appears flat, the delta of the White River at Stuck forms a crest from which low gradients lead southward, westward, and northward. The valley floor was originally covered by a dense growth of forest and undergrowth. There were extensive marshes at several places in it, particularly along its western side and at its northern end. It was, moreover, subject to annual floods.

All the qualities mentioned were in the pioneer period obstacles to settlement, and imposed a distinct pattern on settlement when it was at length achieved. The river was long the only means of transportation through the valley, and farms were located on its banks, by preference in spots where the vegetation was less dense than elsewhere. By about 1865 all the good land fronting on the river was occupied. Produce was taken to Seattle, a rapidly growing lumber town, by boat.

The pioneer period of diversified agriculture was succeeded in the eighties of the last century by a boom period of hop growing. In the same decade a railway was built through the valley. The hop boom collapsed in the nineties. Growth of

Seattle and Tacoma and good transportation by the railways widened the market for truck crops and dairy products, and the development of intensive truck farming laid the foundation of the present principal use of land in the valley. Intense specialization in truck gardening yields produce that in a canned or frozen state is now marketed far beyond the local areas of consumption. The original obstacles to settlement have been overcome, but the intensive use of the land for horticulture has brought new difficulties in the form of deterioration of the originally productive soil, overcapitalization of the land, and absentee landlordism.

The Cranberry Industry of Western Washington. Albert L. Seeman, University of Washington, Seattle.

Abstract: In 1881 the first planting of cranberries in the state of Washington was made by the Chabot Brothers near Long Beach. This planting, modeled after the practices followed in Massachusetts, was made near a lake, in order to insure an adequate supply of water for irrigation and protection from frost. From time to time plantings were made by a few others, who followed the example and methods of the Chabots. From about 1909 to 1916 an artificial real estate promotion brought about a rapid increase in acreage near Ilwaco and Long Beach. Several hundred acres were planted in this period, but many of the enterprises were commercially unsuccessful. In 1924, a few small tracts of one to five acres in area were planted near Grayland. About 90% of the acreage in that vicinity is now owned by people with Finnish names. The acreage near Grayland has increased steadily since 1924. While it is impossible to state accurately the area planted to cranberries in the state, it has been estimated that at present it amounts to between 700 and 800 acres. Not more than one tenth of the bogs suitable for cranberries have been improved.

The cranberry industry, while comparatively new in Washington, has become an important feature of the agriculture of Pacific and Grays Harbor Counties in Western Washington. About 75% of the berries are sold through the Growers' Marketing Exchange under the brand of the Pacific Cranberry Exchange. Some growers, however, prefer to sell their product independently, and much of it goes to chain stores or is consigned to commission houses.

(This paper will be published in full in a forthcoming issue of *Economic Geography.*)

Scenic and Recreational Resources of the Pacific Northwest. Margaret Thompson, Northwestern Conservation League, Chelan, Washington.

Abstract: In the early years of this century several of the cities of the Northwest employed specialists to draw plans for the guidance of their future growth. These plans were, however, ignored; and the cities, now much larger and encumbered with more expensive improvemnts, are attempting to recover, again with the aid of planners, values lost by their negligence in the past.

But the most important planning problems today are those associated with small towns and the open country, since the principal accretions to population occur outside the cities and since the areas having recreational value lie in sparsely settled or unoccupied territory. Several agencies share in the organization of outdoor recreational facilities, conspicuously the instrumentalities of the states charged with responsibility for state parks, the National Park Service, and the Forest Service. Oregon has at present 115 state parks, not all of which are improved. The incorporation of other areas into the park system is under consideration. Idaho has one state park, but no state agency the duty of which is the administration of a park system. Montana has no state parks. Washington has 53, not all improved, and the acquisition of land for others has been recommended.

Administration of the largest areas of recreational land in the Northwest is vested in Federal agencies, namely the National Park Service and the Forest Service. The areas managed by them are organized into three national monuments, four national parks, and five large primitive areas within national forests. Other areas that are worthy of inclusion in the national park system are the volcanic area including Mt. St. Helens, Mt. Adams, Glacier Peak, and Mt. Baker, and a section of the seashore in southwestern Oregon.

The large areas devoted to public recreational purposes will not wholly fulfill their purposes without protection of roadsides from defacement for commercial

purposes. Administrative devices for protecting them exist elsewhere, and only await application to the Northwest. Planned allocation of suitable areas to recreational uses would secure for the future the Northwest's already large income from tourists.

Wild Plants and Minor Forest Products of Western Washington. Woodrow Clevinger, University of Washington, Seattle.

Abstract: A secondary forest industry, based on the gathering and marketing of minor forest products, has grown up in the Douglas fir forests of western Washington. It is most conspicuous in the cutover lands of the Puget Sound Lowland and in the isolated valleys of the Olympic and Cascade Mountains, where many of the inhabitants depend for their limited incomes on seasonal work in the forests. While many of the products gathered enter into commerce, their subsistence value to the rural population is even greater than their sales value.

Fruits of the blackberry species *Rubus ursinus* and *R. Laciniatus* are sold commercially. Those of the huckleberries *Vaccinium ovatum* and *V. parvifolium*, and of the elder, *Sambucus callicarpa*, are gathered largely for use at home. Members of the family Cruciferae provide wild greens. Nuts of the hazel, *Corylus californica*, are eaten. Several wild grasses are cut for hay. A folk medicine, that makes use of native plants the properties of which were learned from the coastal Indians, is practised among a mountain population of southern Appalachian stock. Its materia medica included cascara sagrada—the bark of *Rhamnus purshiana*—and the bark of the wild cherry *Prunus emarginata*.

Cascara bark has been gathered and sold since 1902. In the last decade experimental plantings of the tree have been made, but these provide only a small part of the bark sold. Efforts are being made to introduce other wild plants of the region to the drug industry, notably the foxglove, *Digitalis purpurea*, and the roots of the devil's club, *Fatsia horrida*. The distillation of mint oil from both native and introduced species is already well established in the brackish flats of the estuary of the Columbia, particularly on Puget Island.

Geographic Aspects of Columbia River Development. J. Wright Baylor, Portland, Oregon.

Abstract: The economy of the Pacific Northwest has hitherto been based largely on the destructive exploitation of forests, range vegetation, and the soils of land used in agriculture. As a result, much of the land has been rendered worthless by the ravages of fire and accelerated erosion by water and wind. Concentration of economic activity in the extractive industries has also led to neglect of manufacturing, though the region uses many manufactured products.

The improvements of the Columbia River now in progress promise amelioration of the evil results of past abuse of the country's resources. Those improvements that are directed primarily toward facilitating navigation will help lower the costs of transportation to and from the upper parts of the drainage basin of the river, and so will benefit all enterprises situated there. Electric power at the several dams along the river will encourage the establishment of needed industrial enterprises. Sale of electric power will carry the cost of pumping water for use in irrigation.

The prospective consequences of the improvements of the Columbia thus run through the whole economic structure of the Northwest. Diversification of enterprise, particularly through the establishment of industries using cheap electric power, will alleviate the distress caused by depletion of the original natural resources. Cheaper transportation and electricity used in existing industries will lower costs of production and marketing. Irrigation of the land now unproductive will lighten the burden resting on land now used for agriculture and grazing, and so assist in the achievement of balance in the use of resources.

Annual Dinner, Friday Evening, June 21.

The Edge of the Desert. Forrest Shreve, Desert Laboratory, Tucson, Arizona. (Published in full in this issue.)

The Ainu of Northern Japan. Frances M. Earle, University of Washington, Seattle.

Saturday Forenoon Session, June 22.

A Radio Conservation Project: Hold That Soil. Elmer D. Fullenwider, Seattle Public Schools, Seattle, Washington.

Visual Aids for Geography Teaching. Julia A. Shourek. Seattle Public Schools, Seattle, Washington.

Geography in the Pacific Northwest. Worth McClure, Superintendent of Schools, Seattle, Washington.

Annual Business Meeting.

The following two resolutions were presented and adopted:

1. That the members of the Association of Pacific Coast Geographers wish to express their appreciation to the University of Washington for the facilities and many courtesies provided for the meeting, and especially to the Local Committee and its Chairman, Dr. Frances Earle, for the efficient way in which everything was run.

2. That the Secretary of the Association of Pacific Coast Geographers be instructed to notify the National Research Council that our Association desires to be of service in the case of any national emergency and to inquire what steps may be taken to insure such coöperation.

The following two motions to amend the Constitution were offered and adopted:

1. That an amendment be provided in the Constitution and By-Laws of the Association of Pacific Coast Geographers making the position of Editor appointive. The Editor of the **Yearbook** should be appointed by the three elective officers of the Association, who constitute its Executive Council, for a period of three years.

That an Editorial Board of three be created, including the Editor, the President, and a third member selected by the Editor and the President.

The duties of the Editorial Board shall be: 1. To make business arrangements for publication of the **Yearbook.** 2. To select papers to be printed in the **Yearbook.** 3. To assist in proofreading and other detail.

2. That a student membership, open only to undergraduate students in geography, be created. Student membership shall carry all privileges of the Association, except that of voting. Dues of student members shall be one dollar annually.

Business Meeting of the Executive Council, September 20, 1940

In addition to the regular business meeting held June 22, 1940, the Executive Council met in Berkeley, California, on September 20, 1940, to consider several matters pertaining to the Association.

John Leighly, University of California, Berkeley, was chosen Editor, and Hallock F. Raup, Eastern Washington College of Education, Cheney, the third member of the Editorial Board, in accordance with the provisions of the first of the two amendments to the Constitution cited above. The Editorial Board for 1940-1941 thus includes the Editor, the President, **ex officio,** and Mr. Raup.

The Executive Council also approved the following actions: 1. To include in the **Yearbook** for 1940 a summary of the business meetings, a list of the members of the Association, and a list of new studies under way. 2. To increase the number of students in the membership under the new provision of the Constitution for student membership. 3. To survey the teaching of geography in the junior colleges.

Financial Statement, 1939-1940

Disbursements:		Receipts:	
Yearbook	$219.92	Dues	$256.00
Mimeographing, etc.	43.50	Sale of **Yearbook**	65.60
		Plates	10.14
Total	$263.42	Total	$331.74

Net Income, 1939-1940	$68.32
Balance, 1938-1939	$186.72
Balance in Bank, June 15, 1940	$255.04

Frances M. Earle,
Secretary-Treasurer, 1939-1940

OFFICERS, 1940-1941

President, Frances M. Earle
Vice-President, J. O. M. Broek
Secretary-Treasurer, Joseph E. Williams
Editor, John Leighly
Third Member of Editorial Board, Hallock F. Raup

MEMBERS OF THE ASSOCIATION (NOVEMBER, 1940)

Burton Adkinson, Clark University, Worcester, Massachusetts
Stanley Akerson, Route 1, Ellensburg, Washington
Agnes M. Allen, State Teachers College, Flagstaff, Arizona
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Wilbur A. Anderson, Public Schools, Bothell, Washington
John B. Appleton, Northwest Regional Council, 606 Bedell Bldg., Portland, Oregon
Gordon D. Aumack, 507 N. Laurel Avenue, Los Angeles, California

Margaret Bancroft, San Diego, California
Ruth E. Baugh, University of California at Los Angeles, Los Angeles, California
J. Wright Baylor, 1605 NE 57th Street, Portland, Oregon
Charles Noble Beard, State Teachers College, Fresno, California
Arthur B. Biggs, American Institute, Cajon 9, La Paz, Bolivia
Malcolm Bissell, University of Southern California, Los Angeles, California
Donald D. Brand, University of New Mexico, Albuquerque, New Mexico
J. O. M. Broek, University of California, Berkeley, California
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Leonard Ekman, Public Schools, Bothell, Washington

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Hugh Fothergill, Clover Park High School, Tacoma, Washington
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Walter Hacker, San Francisco State College, San Francisco, California

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Enid Miller Stevens, New Haven, Connecticut
Alvena Storm, San Diego State College, San Diego, California
Helen Strong, U. S. Soil Conservation Service, Washington, D. C.
C. K. Studley, Chico State College, Chico, California

Harold E. Tennant, 1500 E. 62nd Street, Seattle, Washington
Margaret Thompson, Northwest Conservation League, Chelan, Washington
J. Allen Tower, Birmingham-Southern College, Birmingham, Alabama

Charlotte Upham, Lewis and Clark Junior High School, Astoria, Washington

B. M. Varney, University of California at Los Angeles, Los Angeles, California
A. G. Vestal, University of Illinois, Urbana, Illinois
Maxim von Brevern, University of Washington, Seattle, Washington

Wayne A. Wallace, University of California at Los Angeles, Los Angeles, California
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Joseph E. Williams, San Francisco Junior College, San Francisco, California

C. M. Zierer, University of California at Los Angeles, Los Angeles, California

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Members are requested to inform the Secretary-Treasurer concerning any changes of address.

Announcement of the Annual Meeting in 1941

The Seventh Annual Meeting will be held in Pasadena, California, during the week of June 16 to 21, 1941, in connection with the annual meeting of the Pacific Division of the American Association for the Advancement of Science.

THE ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

THE ASSOCIATION of Pacific Coast Geographers was organized on June 27, 1935. The object of the Association, in the words of its Constitution, is "the promotion of scientific research in Geography and the diffusion of the resulting scientific knowledge." Annual meetings are held in June, usually in conjunction with the Pacific Division of the American Association for the Advancement of Science.

Membership is by invitation; and in practice has generally been limited to those having professional training in geography. Student memberships, open only to undergraduate students in geography, carry all privileges except that of voting. Annual dues are two dollars for regular members and one dollar for student members.

The Association publishes annually the **Yearbook of the Association of Pacific Coast Geographers.** The **Yearbook** contains the proceedings of the Association, abstracts of papers presented at its annual meetings, and a few papers selected from those presented to be published in full. The price of the **Yearbook** to non-members and libraries is one dollar per copy.

Correspondence should be addressed to the Secretary-Treasurer.